SECTION I

GENERAL

General

The AF, AG, AJ, AK, AL, and AM relays constitute a class of relay characterized by card operation of pretensioned wire-spring subassemblies. The important characteristics that have been attained in these wire-spring relays with respect to the U, UA, UB, and Y relays are:

1. Lower cost
2. Faster operate and release times
3. Sensitivity and marginal capability comparable to that of UA relay
4. Slow release times comparable to those of Y relay
5. Reduced contact chatter and armature rebound
6. Negligible contact locking
7. Fewer open contacts
8. Reduced contact erosion and faster opening of contacts and low contact load energy
9. Greater life and adjustment stability and nonaging magnetic material
10. Low magnetic interference
11. Spring combination switching capability equivalent to U relay (Greater spring capacity has been obtained.)
12. Lower cost of wiring
13. Single contact metal and size (palladium)
14. Lower power consumption

The various design and engineering characteristics of the wire-spring relays are presented in this bulletin. The new relays are not interchangeable, from a mounting standpoint, with the U, UA, UB, and Y relays; consequently, equipment, as well as circuit engineering, is required in applying them to switching systems.

Description

The AF, AG, AJ, and AL wire-spring relays consist of an armature, a core, three molded spring blocks or combs, and a moving card, all held together by a spring clamp that has sufficient tension to hold the parts in rigid alignment. There are separate twin-wire blocks for makes and breaks, and a single-wire block, which is associated with the twin-wire makes or breaks. The twin wires are actuated by a moving card, making and breaking contact with the contacts of the stationary single-wire block. The contacts are arranged in 12 positions in a vertical row. Each position may have a make, a break, a make-break, or a break-make spring combination. The make-and break-contacts can be operated in three stages of the armature travel; the stages are commonly termed late, early, and preliminary.

The AK and AM relays are similar to the AF relay except that the armature and card are divided horizontally, effectively making two relays on one structure. Spring positions 6 and 7 are not used. Only two stages of contact operation, early and late, are used.

Connection to the wiring terminals of all relays is obtained by wrapping the connecting wire around the straight terminal. The terminals are satisfactory for solderless wrapped connections.

Relay Types

There are six types of wire-spring relays: AF, AG, AJ, AK, AL, and AM.

AF Relay

The AF relay is used as the general-purpose relay with a load capability of 18 contact pairs, and is equipped with a short armature (0.062-inch thick and 1/2-inch legs). This armature has been provided to reduce armature rebound when the relay releases. It is always provided with stop discs of 0.006-inch, 0.014-inch or 0.022-inch thickness, as required to meet circuit conditions. The core is zinc-plated and the armature and backstop thinly chromium-plated to eliminate sticking on the backstop. In addition to the operate requirement, nonoperate, hold, or release requirements may be specified for marginal applications. Fig. I-1 and I-2 show the front and rear views of this relay.

AG Relay

The AG relay, which generally has a copper or aluminum sleeve (Fig. I-3) over the center leg of the core, is a slow-release relay to replace the Y relay. Slow-releasing action may also be obtained by the use of a noninductive shunt or a short-circuited secondary winding. It is equipped with a long armature (0.078-inch thick and 1-1/4-inch legs) without stop discs, but embossed where it strikes the core, similar to the Y relay armature. The armature and core are chromium-plated. Hold and release

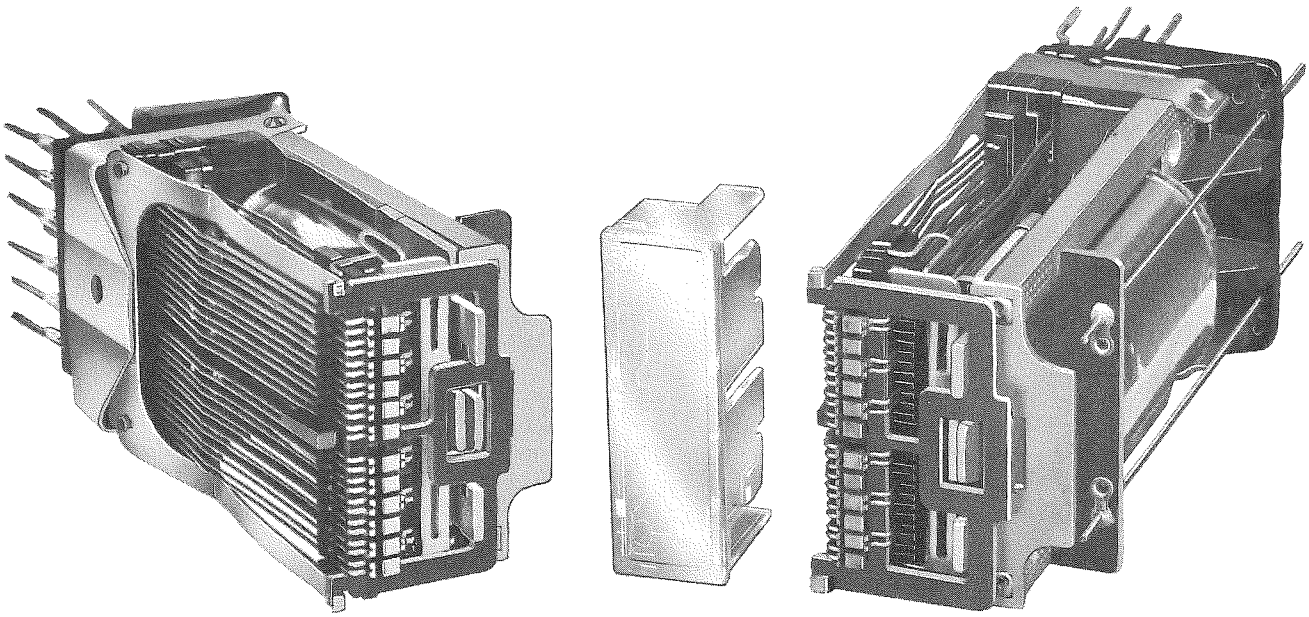

Fig. I-1 - AF Relay (Front View)

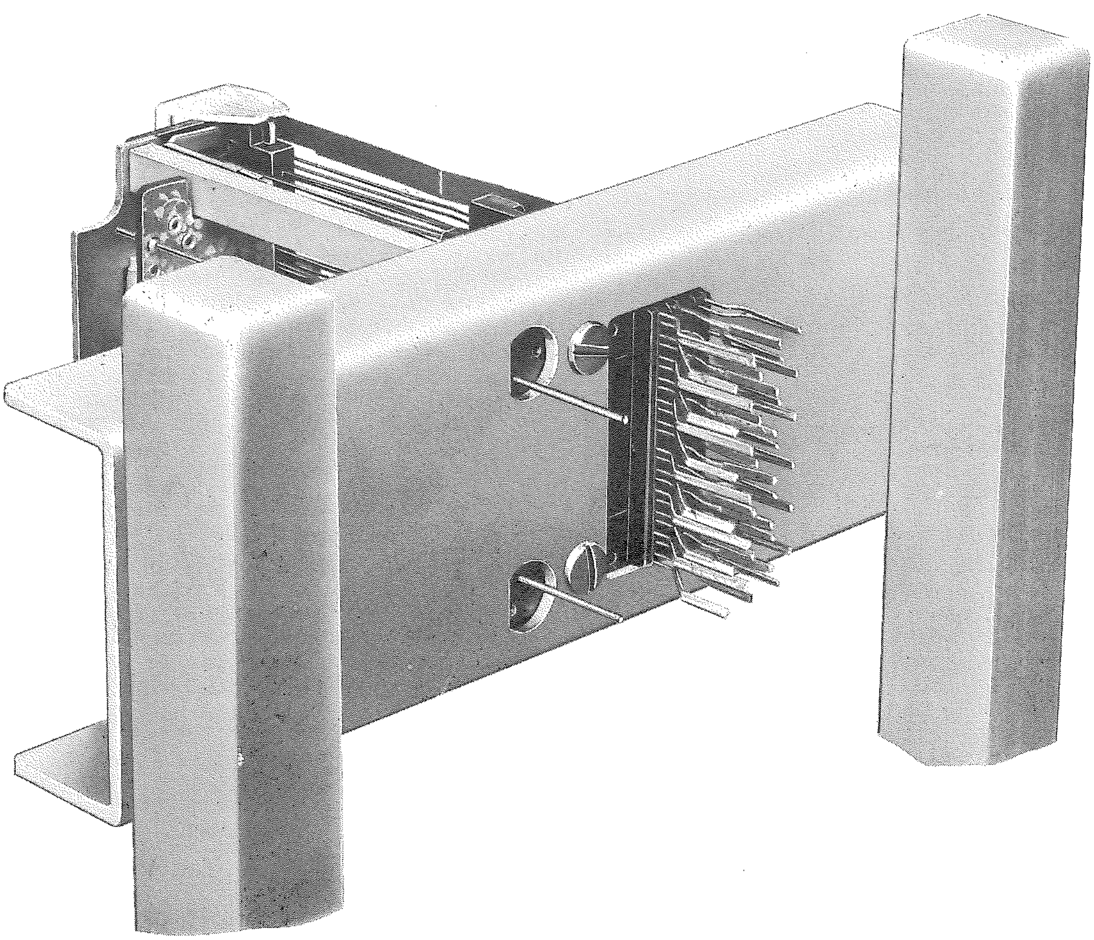

Fig. I-2 - AF Relay (Rear View)

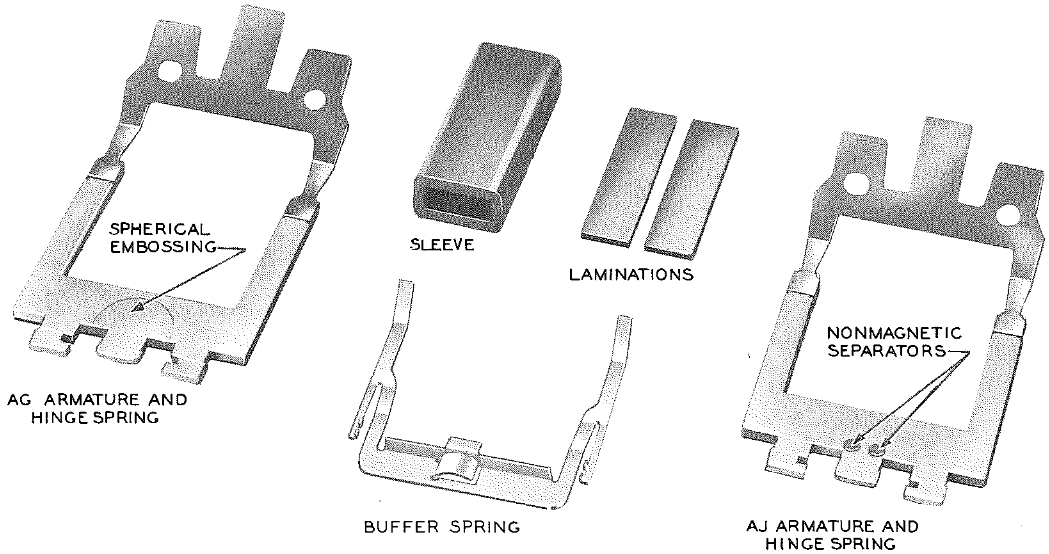

Fig. I-3 - Additional Parts for AG and AJ Relays

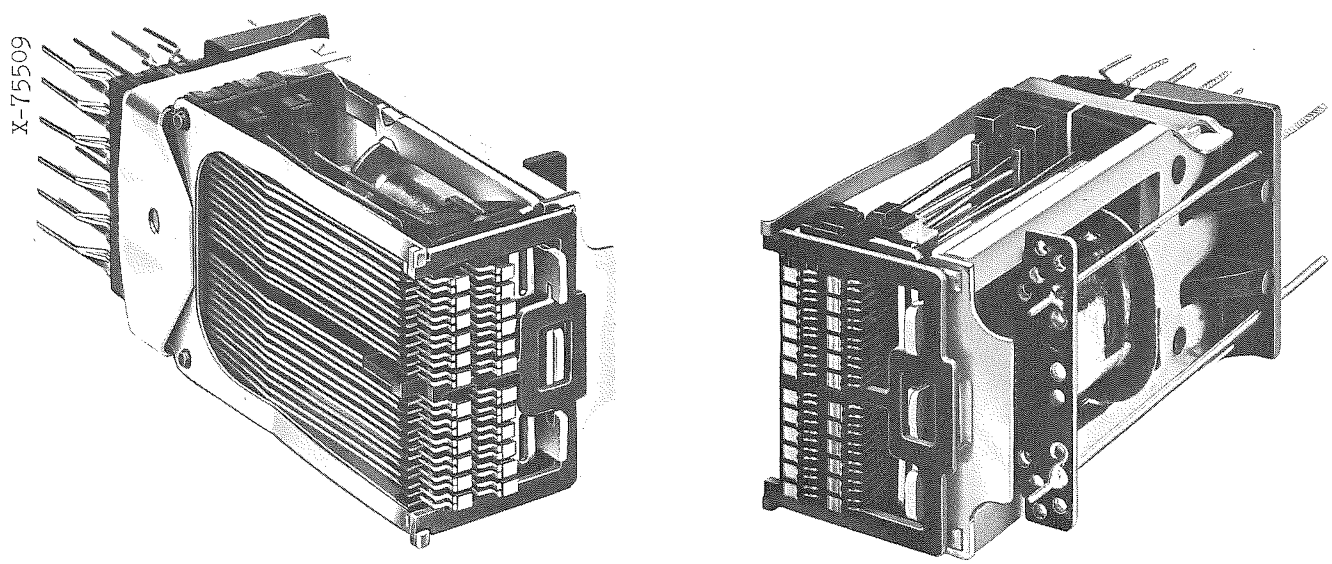

Fig. I-4 - 24 Make- and 24 Break- Contact Relay

requirements are always specified in addition to the operate requirement in order to control the spread between minimum and maximum releasing times.

AJ Relay

The AJ relay is used for operating the heavier spring loads and also for light loads where greater sensitivity is required. It is equipped with the long armature and always provided with 0.006-, 0.014-, or 0.022-inch thick stop discs, as required to meet circuit conditions. The core is zinc-plated and the armature and backstop thinly chromium-plated to eliminate sticking on the backstop. Nonoperate, hold, or release requirements may be specified for marginal applications.

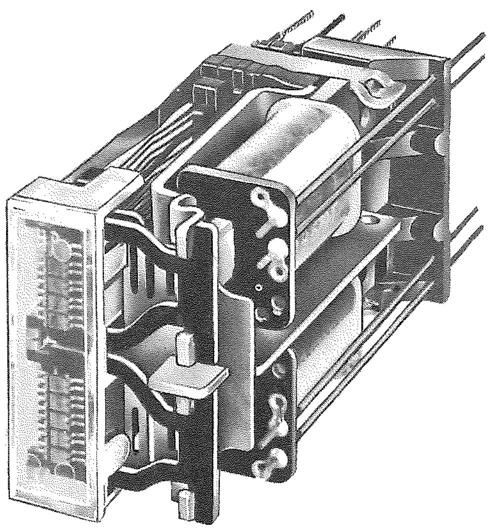

Fig. I-5 - AK and AM Relays

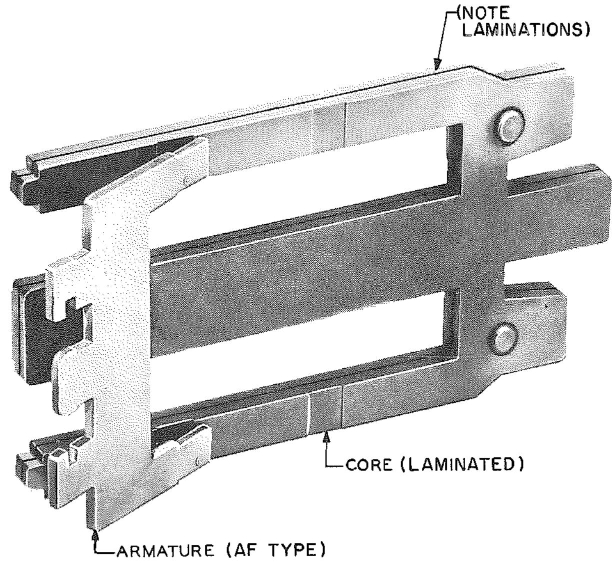

Fig. I-6 - AF Relay Magnetic Structure

The AJ relay may be equipped with core laminations (Fig. I-3) consisting of a strip of iron on each side of the core. This increases the impedance so that the relay may be satisfactorily used as a bridged impedance transmission relay. A relay equipped with core laminations will also pull heavier spring loads.

24 Make-Contact Relay

A special variety of the AJ relay has been made available for conditions where more than 12 make-contacts are required. This relay can replace two relays, or can be used where a multicontact relay might otherwise be required.

The 24 make-contact relay uses four molded wire blocks, two single-wire blocks, and two twin-wire blocks. The contacts are arranged in two vertical rows of 12 contacts each, as shown in Fig. I-4.

24 Break-Contact Relay

A 24 break-contact version of the AJ relay is also available for use where more than 12 break-contacts are required. It is similar to the 24 make-contact relay in appearance and construction. The contacts are arranged in two vertical rows of 12 contacts each, as shown in Fig. I-4.

AK Relay

The AK relay is essentially two relays that mount like a single relay. There is a single core plate, core and balancing spring, but two armatures and two actuating cards. The twin- and single-wire combs for the two relays are molded as single units. Fig. I-5 shows the general appearance of the relay.

The AK relay has a capacity of five contact sets on each half. Each contact set may be a make, break, break-make, early break-make, or early make-break. No preliminary contacts are available, since there is no long-travel AK relay.

AL Relay

The AL relay is a magnetic latching variation of the general purpose type wire spring relay. It has been designed to (a) operate on relatively small amounts of power, (b) operate and release in times of extremely short duration, (c) remainlatched (operated) with current removed, and (d) release only when a reverse current is applied. Contact arrangements currently available on AF-, AG-, and AJ-type relays may be obtained on the AL-type, also. In appearance, it is identical to the AF-type relay.

AM Relay

The AM relay is a magnetic latching version of the AK dual armature relay. The contact arrangements and coil resistances available are the same as for the AK. It has the same operating characteristics as the AL relay with regard to its magnetic latching features.

Magnetic Structure

The magnetic structure of the AF, AG, and AJ relays consists of a laminated E-shaped core and a flat U-shaped armature (Fig. I-6). Silicon iron is used for the armature in preference to magnetic iron because it has a higher resistivity, which contributes to faster operating and releasing times and also has much less magnetic aging properties. The E-shaped core, originally of one-piece construction, is made of two pieces of 1010 low carbon steel, resulting in a slight improvement in mag-

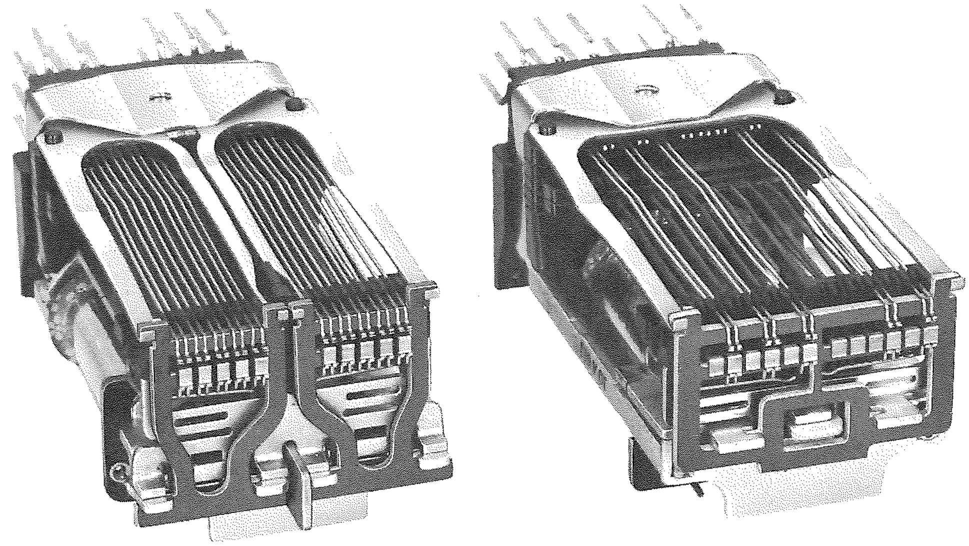

Fig. I-7 - AF and AK Relay Balance Springs and Cards

netic capability while materially reducing the cost. The relatively wide spacing of the core legs reduces the leakage, thus increasing the useful magnetic flux. The AL relay core is made from a single piece of 1045 medium carbon steel in order to obtain the desired magnetic latching characteristics.

Two different armatures are provided: a short armature, 0.063-inch thick with legs 1/2-inch long for the AF relay and a long armature, 0.078-inch thick with legs 1-1/4-inch long for the AG and AJ relays. Both armatures are coined to a thickness of 0.058-inch at the front, where they pass through the opening in the core plate, so that the same core plate may be used regardless of the armature used. The AF and AJ relays are equipped with nonmagnetic separators, or stop discs, 0.006 inch 0.014 inch or 0.022 inch high. The stop discs vary -0.000 inch, +0.003 inch. The AG relay armature has a spherical embossing (Fig. I-3). The stop discs prevent an iron-to-iron contact between the armature and the core, and the embossing provides a more uniform reluctance between the armature and the core for the slow releasing AG relays. The armature is supported by a hinge attached to the two legs in such a manner as to produce a minimum rebound when the relay releases.

The magnetic structure of the AK and AM relays differs considerably from that of the other wire spring relays. The core is U-shaped (Fig. I-5) and the coils are placed over the two legs. Both the AK and AM cores are of one-piece construction, differing only in the grade of steel used, and the method of heat-treating.

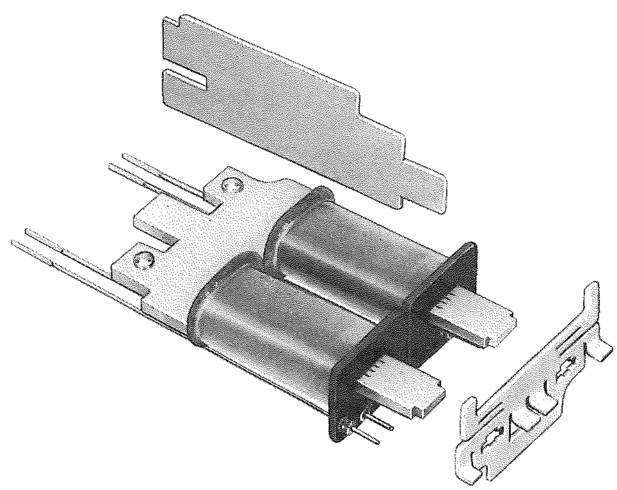

Fig. I-8 - AK Relay Coil Assembly and Core Plate

The U-shaped armature is replaced by a flat armature that has a double offset (see Fig. I-5) to fit around the coil. Only one stop disc height, 0.005 inch, has been used. Where slow release times are required, a spherical embossing similar to that on the AG relay is used.

Balance Spring

The armature of the AF, AG, AJ, and AL relays is held against the backstop by a pretensioned U-shaped balancing spring (Fig. I-7). There are eight balancing springs of various thicknesses with different offsets,

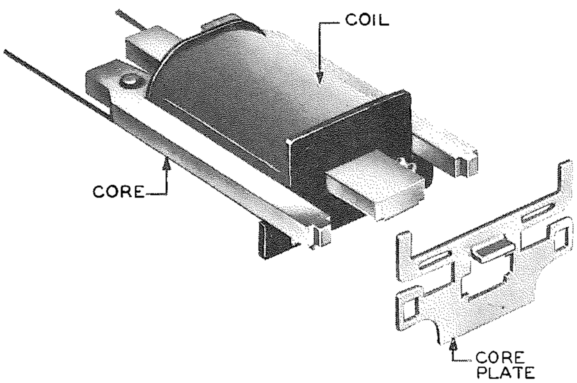

Fig. I-9 - AF, AG, or AJ Relay Coil Assembly and Core Plate

and the one used on any particular relay depends on the number of make-contacts on the relay. These springs may be adjusted within certain limits to meet marginal circuit conditions.

Each armature of the AK and AM relays is held against its backstop by two arms of a balancing spring (Fig. I-7). There are two balancing springs, and the one used depends on the number of make-contacts on the relay.

Core Plate

AF, AG, AJ, and AL Relays

After a cellulose acetate filled coil (see Section X) has been assembled to the center leg of the core, a core plate (shown in Fig. I-9) is forced over the ends of the E-shaped core to hold the three legs in good alignment for proper mating with the armature. The speed and pull depend, to an important extent, on the alignment of the armature with respect to the three legs of the core. A clearance is required between the armature and the side legs to insure that the armature hits the stop discs, or dome, and not the side legs. On the other hand, if this side-gap clearance is too large, a loss of pull capability results. A lip on the core plate serves as a backstop for the armature. The core plate also provides a means of mass-adjusting the contacts. This can be done by inserting a screwdriver in the upper or lower adjusting slots and twisting the screwdriver. The lower slot controls contacts 1 through 6; the upper slot controls contacts 7 through 12. The armature travel is governed by the height of an opening in the core plate, the armature thickness, and the stop-disc height. Thus, a separate core plate is required for each of the three stop-disc heights and each armature travel stage.

AK and AM Relay

A single core plate (Fig. I-8) fits over the cores of the two halves of the relay. It provides the same method of adjustment as that of the AF relay, except that the upper slot controls the adjustment of the top relay unit and the lower slot the bottom relay unit. The core plate has two lips, one serving as the backstop for each relay unit.

Spring Assemblies

One of the major features of the relay is the use of molded spring assemblies.

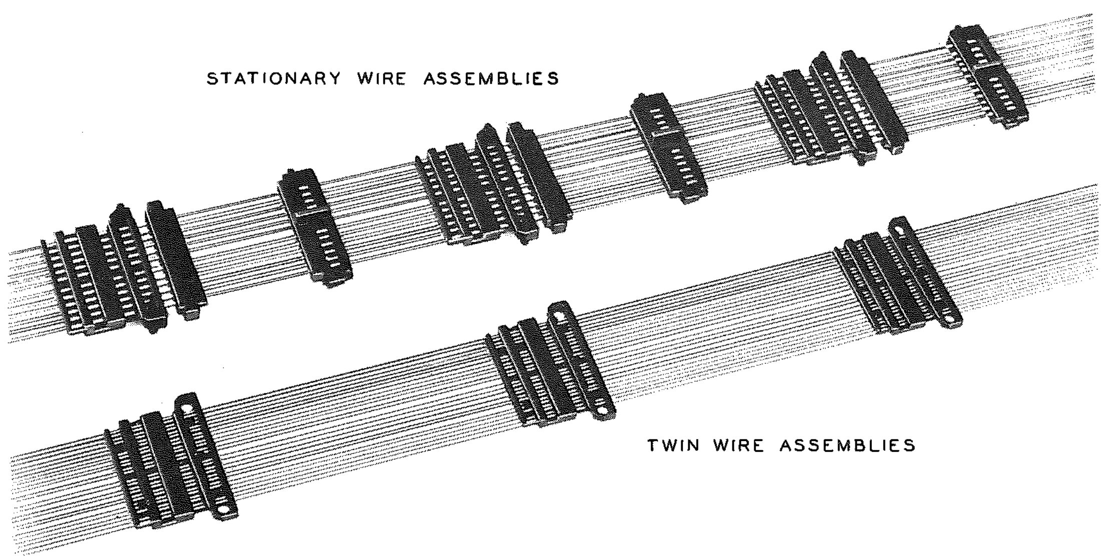

Fig. I-10 - Molded Spring Assemblies Before Cutting to Length

A number of wires are fed into a molding press, where a plastic block is molded around the wires to hold them in place. The molds are also shaped to provide dowel pins and holes in the molded blocks which facilitate the relay assembly and hold the parts in alignment. Fig. I-10 shows continuous ladders of molded wire spring sections before they are cut to length.

In general, three basic wire spring assemblies, or combs, are required. Two of these carry twin wires of copper-nickel for make- and break-contacts and are identical except for some details in forming at the terminal end for convenience in wiring. The third comb consists of a group of 12 (ten on the AK and AM relays) relatively heavy copper-nickel single wires molded in plastic sections, one a short distance behind the contacts and the other near the terminal end of the relay. These sections are rigidly supported in the relay structure. The twin-wire

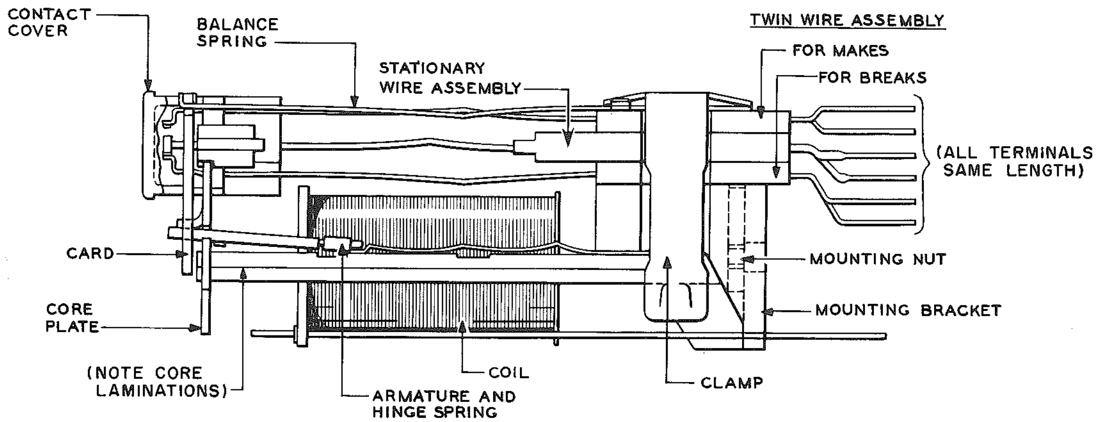

Fig. I-11 - Top View of AF Relay Showing Location of Parts

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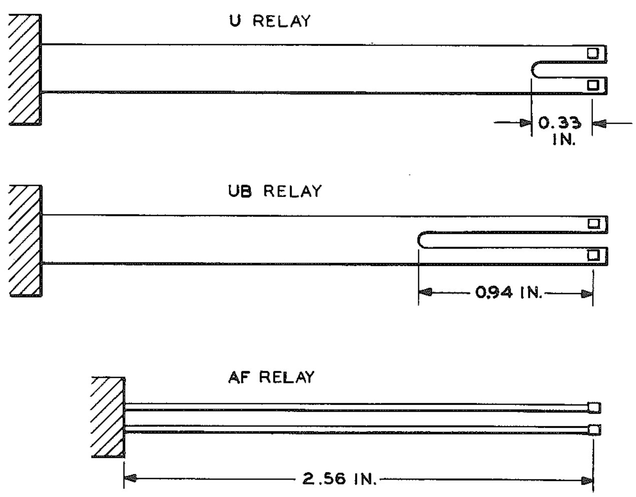

Fig. I-12 - U, UB, and AF Relay Springs

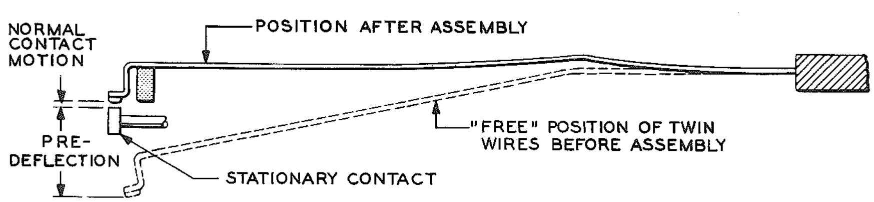

Fig. I-13 - Predeflection of Twin Wires

assemblies are mounted on either side of the stationary single wires. Fig. I-11 shows a top view of the relay and the location of the parts.

Contacts on the movable twin wires are associated with the single fixed contact. The twin wires are held in good alignment with the single contacts by molded guide slots in the single-wire comb just behind the card. These slots are slightly wider than the wires so that the wires are free to move in the direction of the single wires but are restrained in the lateral movement. Fig. I-12 shows the independent action of the twin contacts compared with the limited action of the twin contacts on the U and UB relays. This contact arrangement assures contact reliability and reduction of open contacts in the presence of dirt.

Each group of twin wires is tensioned toward the stationary wires by means of large predeflections (approximately 1/2 inch) before assembly. The contact forces are controlled by this predeflection as illustrated in Fig. I-13. When the twin-wire blocks are assembled in the relay, the twin wires are displaced from their free position by the single contacts or by the actuating card. The stiffness of the twin wires is such that this results in a contact force of about 12.5 grams for each contact pair of a standard wire-block.

The twin wires are actuated by a single punched fiber card, which in turn is actuated by the armature. The tension of the twin wires is always in a direction to hold the contacts closed; therefore, the card must hold the make-contacts open when the relay is unoperated, and the break-contacts open when the relay is operated. The armature back tension is thus the sum of the restoring forces of the balance spring legs, minus the forward tension of the twin wire movable springs of the make-contacts.

The single-wire stationary combs are always provided with a full complement of wires in order to support the front molded section which is held against the core plate by the tension of these wires. Only the single wires mating with twin wires may be equipped with precious metal contacts. Thus, the single wire may be equipped to accommodate a make-contact or a break-contact only, a sequence contact, or no contact, depending on the arrangement.

Actuating Card

The twin wires are actuated by a phenol fiber moving card (Fig. I-7) held against the armature by the tension of a flat balancing spring. The twin wires that form the make-contacts are pretensioned against the outer edge of this card and toward the single mating contacts and the core. As the armature moves toward the core, the card allows the twin-wire springs to move forward to make contact with the single-wire contacts. As the armature movement continues, the card touches the break-twin wires, which are tensioned against the single-wire contacts. As the armature continues to move further towards the core, the actuating card lifts the break-twin wires from the mating single-wire contacts and the break contacts open. The principle of operation is shown in Fig. I-14 for transfer contacts.

Contact Sequences

Contact sequences are obtained by controlling the contact so that it functions early or late in the armature stroke. The particular point at which contacts make or break depends mainly on the dimension of the card between the surface which bears against the armature and that which engages the twin wires. By providing recesses for early makes and shoulders for early breaks, any contact can be made to operate early or late in the armature stroke. Thus, a transfer is obtained by making the card dimension such that a break-contact will open before its associated make-contact closes. A continuity combination is obtained by controlling the card dimensions so that the make-contact closes before its associated break-contact opens. Fig. I-15 shows an early break-make (transfer), an early make-break (continuity), and a break-make (nonsequence transfer) side-by-side. Of the contacts shown, only two operate early, and this is accomplished by means of the two steps in the actuating card. If no different sequences were required, the card would have two straight unbroken surfaces, one for the makes, and one for the breaks.

Combinations with sequences require a longer armature travel than those with no sequences. Three different travels or contact stages are provided. At the card, these travels are: 0.026 inch (short) for no sequences, 0.044 inch (intermediate) for one sequence, and 0.060 inch (long) for preliminary contacts that involve two stages or sequences. The 0.060-inch travel is not used on the AK and AM relays.

Mounting

The relays are mounted with two screws, which engage a clamp plate held in the rear assembly. The molded rear assembly is such that the relays are insulated from the mounting plate without the use of separate mounting plate insulators.

Generally, all relays mount on 2-inch vertical and 1-1/2 inch horizontal centers, except transmission relays requiring a magnetic shield, and the 24 make relay. In the case of the transmission relays, 1-3/4 inch horizontal centers are required.

When mounted next to each other on 1-1/2 inch horizontal centers, the wire spring relays nest in such a manner that there is a nominal clearance of 1/8 inch at the closest points. When mounted next

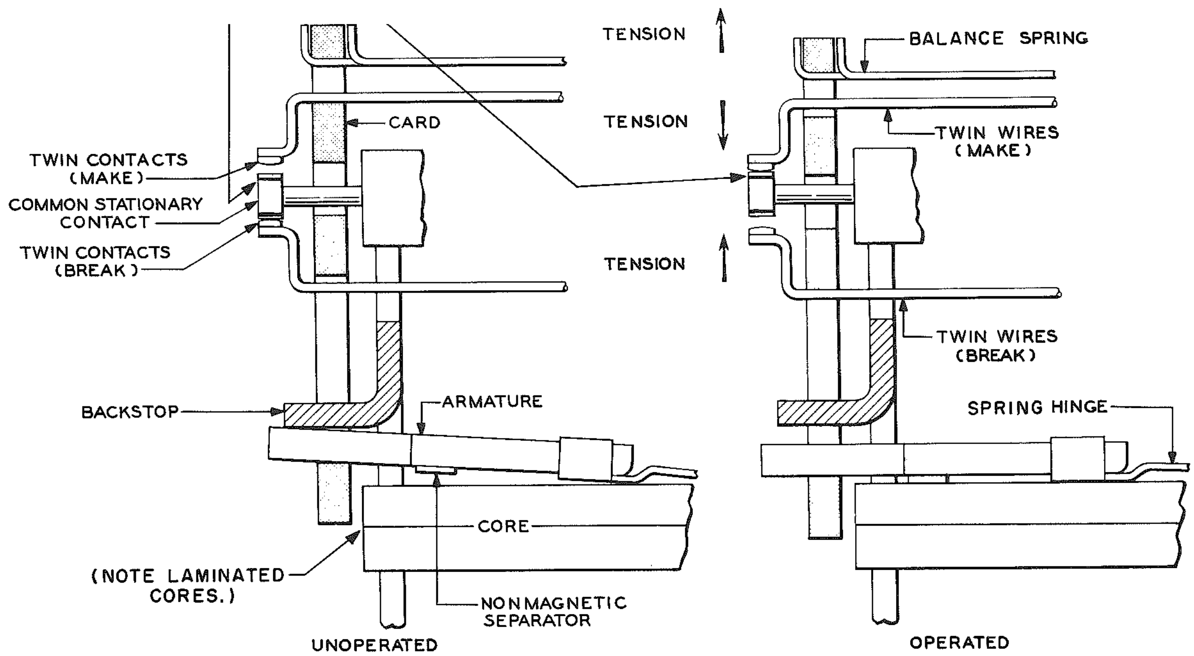

Fig. I-14 - Principle of Operation of Transfer Contacts

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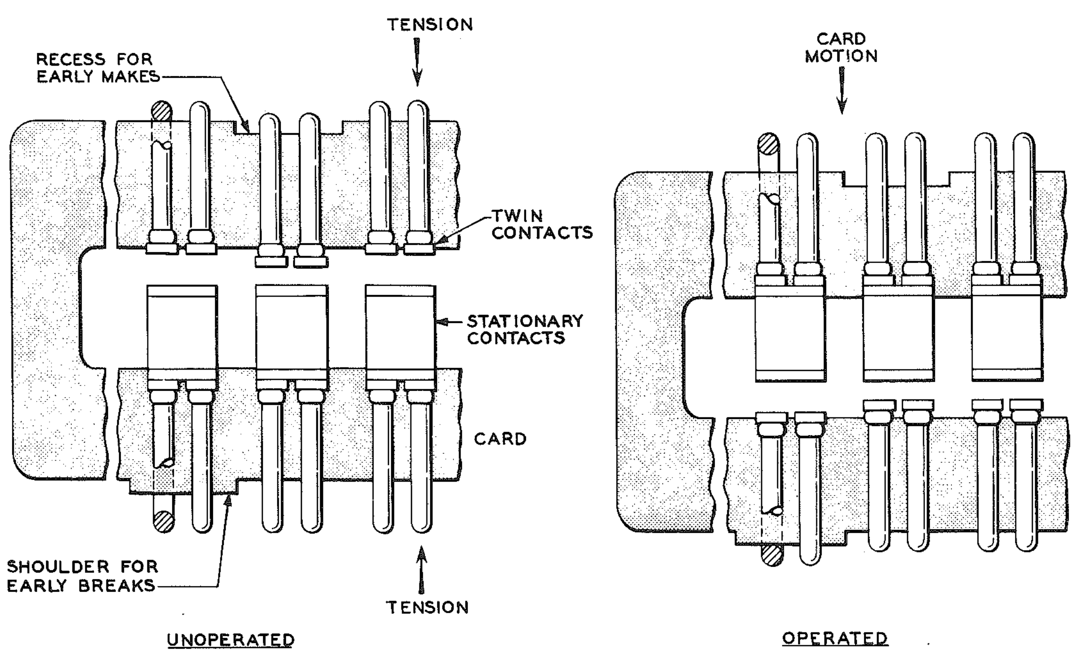

Fig. I-15 - Method of Obtaining Early Contacts to dissimilar apparatus, however, the adjacent apparatus seldom nests with the wire spring relay and somewhat larger space must be allowed. Where no penalties in the number of mounting plates occur, the center-to-center dimension, between the wire spring relay and the dissimilar apparatus, should

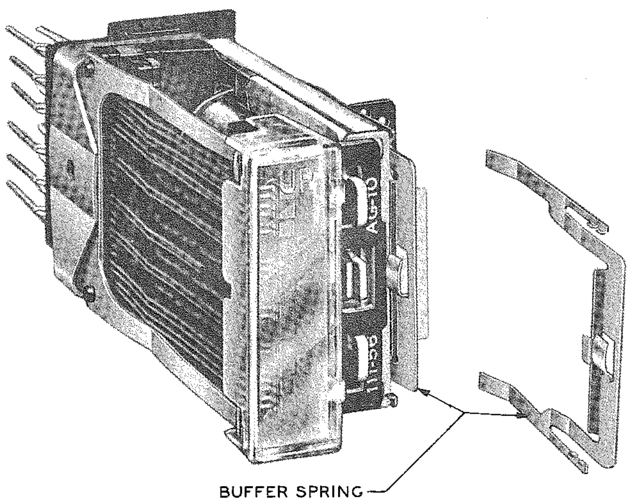

Fig. I-16 - Buffer Spring

be increased 1/8 inch. The AJ relay, equipped with a magnetic shield, is considered dissimilar apparatus since relays equipped with the boxlike shield will not nest.

Where the additional 1/8-inch allowance, due to dissimilar apparatus, will cause the use of an extra mounting plate, the following minimum mounting allowances may be used.

	AF,AG,AJ,AK, AL,AM
Dissimilar apparatus on coil side of relay - all lengths	0.033 inch
Dissimilar apparatus on spring side of relay - 2-7/8 inches or less from mounting plate	0.033 inch
Dissimilar apparatus on spring side of relay - over 2-7/8 inches from mounting plate	0.067 inch

The 24 make relays may be mounted on 1-3/4 inch centers with respect to other 24 make relays, but the use of 2-1/2 inch mounting centers is recommended as a means of reducing the wiring congestion at the back of the relay. When a general purpose wire spring relay is mounted on the spring side of a 24 make relay, the minimum 1-5/8 inch center-to-center spacing should be increased to 1-3/4 inch to obtain an adequate clearance between the outer row of terminals on the 24 make relay and the coil terminals of the general purpose relay. 24-make relays with more than one winding require a special layout of mounting holes and a minimum mounting center of 2 inches.

Assembly of Coded Parts

The design of the wire spring relay permits considerable savings in assembly and adjusting cost. Major design features that contribute to low assembly cost are:

1. The use of molded spring subassemblies, which avoid individual handling of the wire springs.
2. Clamping the relay pile-ups by means of a simple steel spring clamp. No screws are used in the relay except those that fasten it to the mounting plate.
3. A single, easily-mounted operating card.

A large variety of different relay codes are obtained by assembling parts that, for assembly purposes, are identical. Thus, the assembly operation is essentially the same for all codes. A buffer spring (Fig. I-16), which is used to obtain an increased load in the operated position without increasing the unoperated position load, can be placed on the relay (except the AK or AM relay) after the assembly is completed. Fig. I-17 shows the parts that are used in the assembly of the AF relay, and Fig. I-18 the AK relay.

While it is possible to have a great number of different molded spring combs, it is expected that a relatively small number will be adequate for all uses. Relatively few of the large number of actuating cards possible will be used. Only eight have been used on the AF, AG, AJ, and AL relays and four on the AK and AM relays up to the present time.

Contact Cover

Each relay is equipped with a molded styrene-acrylonitrile cover, which encloses only the front of the contacts and protects them from dirt. The cover also traps the twin wires in the individual guide slots to avoid displacement and crossing of these wires such as would occur during shipment and under pressure-cleaning conditions. It is important that the cover be kept in place at all times except for relay maintenance.

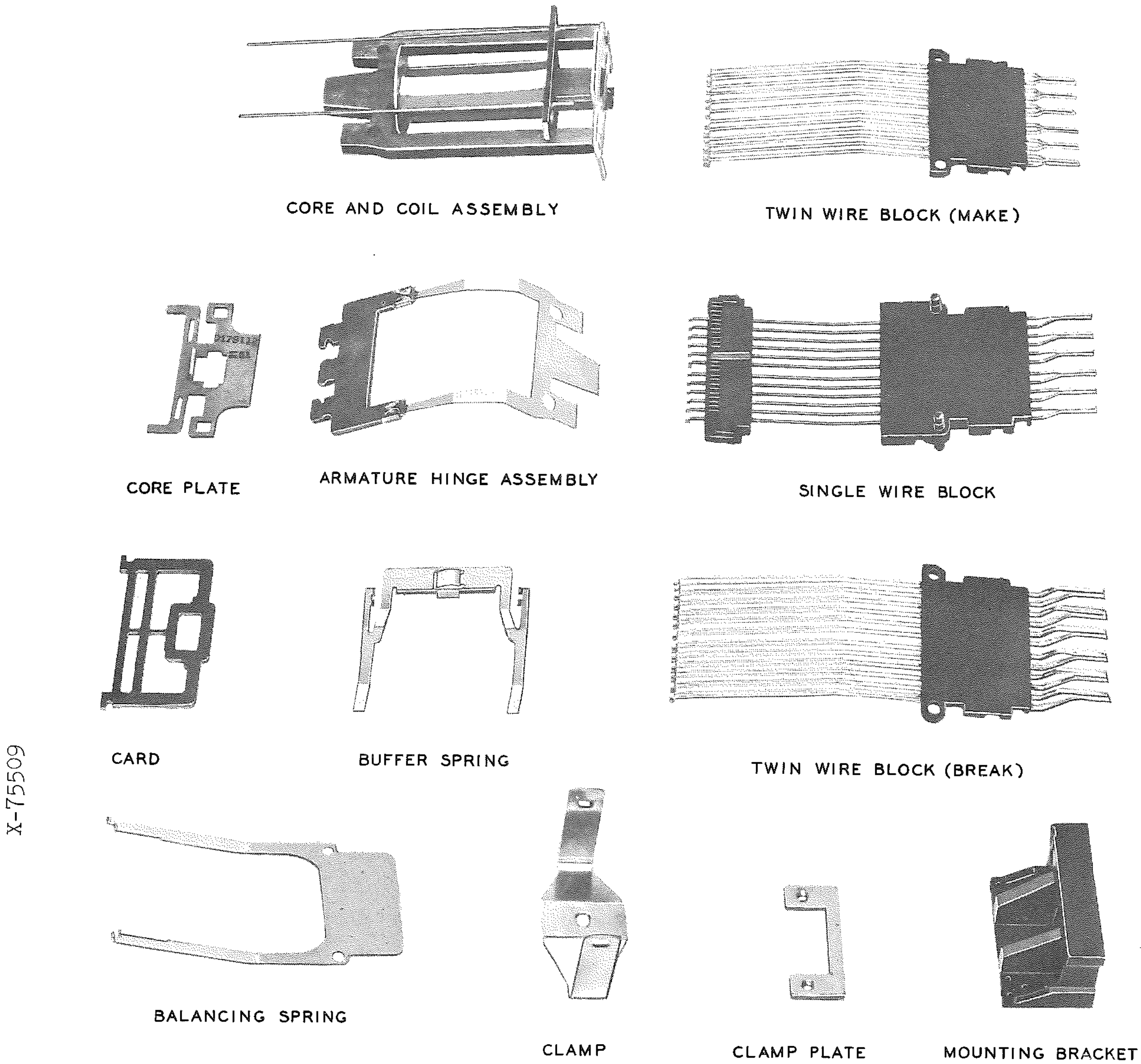

Fig. I-17 - AF Relay Parts

Life

It is expected that AF, AG, AJ, and AL relays will have a life of 100 to 300 million operations depending on the coil resistance and spring combination. Where longer life is essential, special features can be used that will extend the life to approximately one billion operations. These special features consist of heavy chromium plate on the armature, core, and core-plate, stop discs of No. 1 contact metal, and stainless steel wear pads on the core legs in the region where the armature pivots.

The AK and AM relays have a life of about 40 million operations. When long life features, as noted above, are incorporated, these relays have a life expectancy of 100 million operations.

Contact Chatter and Rebound

Contact chatter in general purpose relays has several causes. For convenience in discussing the extent and characteristics of chatter on the wire spring relays, chatter can be divided into four fundamental types, characterized by their cause, as follows:

1. Initial Chatter is chatter occurring immediately after contact closure. This is usually confined to a period of about 100 μsec after closure. It is usually of high frequency and has sometimes been called fine chatter.

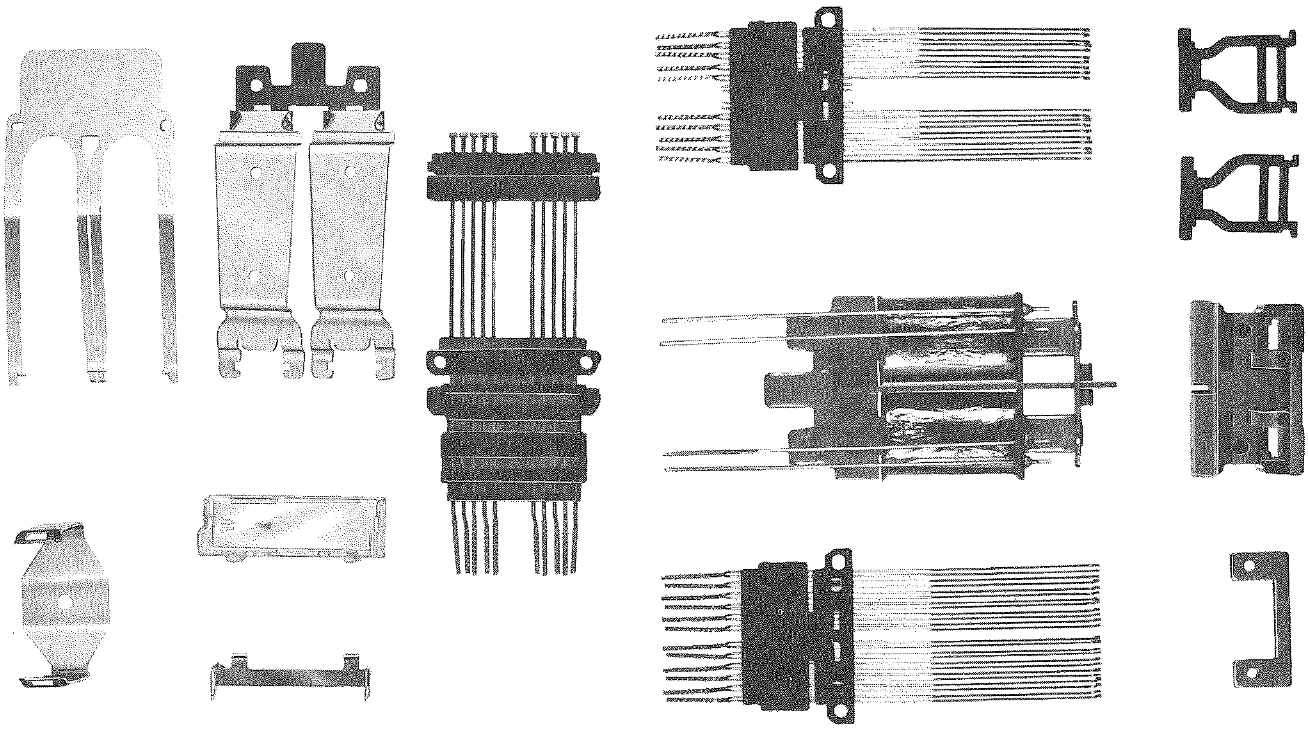

Fig. I-18 - AK Relay Parts

2. Shock Chatter is caused by vibration of the springs resulting from the impact of the armature as it strikes the core or backstop on operate or release. This type of chatter usually starts from 1 to 3 msec after the initial closure and is periodic in nature.

3. Hesitation Chatter is caused by hesitation of the armature during the operate or release stroke. Abrupt changes in load cause the armature to momentarily stop or even reverse its direction of motion before completing its stroke.

4. Rebound Chatter is caused by the bounce of the armature on striking the backstop, on release.

Conditions under which the various kinds of chatter can be anticipated are shown in the following tabulation.

Chatter*	Type of Relay: AF or AJ Controlled by Mass	Type of Relay: AF or AJ Controlled by Load	Type of Relay: Slow†
Initial	✓	✓	✓
Shock	✓		
Hesitation		✓	✓
Rebound - Short A T			✓
Rebound - Int & Long A T	✓	✓	✓

* Checks (✓) indicate conditions where chatter can occur.

† AF, AG, or AJ relays with sleeves or shunts.

The wire spring relays show substantial improvement in performance over older relays in all types of chatter except hesitation and rebound chatter.

Initial Chatter

This type of chatter may occur on any wire spring relay contact, but it will be found more often on the make-contacts of fast-operate or lightly loaded relays. Its occurrence and duration are so small that for most circuit applications it can be neglected. It has some adverse effect on contact erosion, but the effect is included in the life estimates of contact performance.

Shock Chatter

This type of chatter is a function of the armature speed and does not occur on the operate of the slower relays or on the release of lightly-loaded or slow-release relays. It will occur most frequently on the fast-operating speed coils. Its occurrence and duration are so small that for most circuit applications it can be neglected.

Hesitation

Hesitation is a temporary slowing down, stopping, or reversal of the armature during its travel between the core and the backstop on either operate or release. This tends to increase the stagger time between contacts and prolong the operate or release time. Operate hesitation occurs when the spring load builds up faster than the armature pull, and usually occurs on the high-inductance coils or under marginal conditions. Hesitation chatter may also be induced by rebound of the armature under high pulse rate conditions. Operate hesitation is worse on relays with a large number of springs, which are picked up early in the armature travel with little dispersion of the contact pickup points. A change in the adjusting requirements to prevent picking up the contacts too early has practically eliminated hesitation on coils of less than 700 ohms and reduced the tendency of hesitation on the higher resistance coils.

Hesitation may be reduced or eliminated by three methods:

1. Use more power on the coil.
2. Use an adjustment to guarantee a gradual or late load pickup. Adjusting the core plate tabs so that the single-wire comb is moved nearer to the core increases the distance that the armature travels before picking up the load. As a consequence, the armature is traveling faster and the pull is greater as the load is picked up; both factors reduce hesitation.
3. Use an AJ relay in place of an AF relay. The greater pull of the AJ relay, under the same circuit conditions, tends to reduce hesitation.

Release hesitation is encountered almost entirely on relays with buffer springs. When the buffer spring load is dropped, on the release of the relay, the armature may stop or momentarily reoperate some contacts before moving to the backstop. Since the hesitation is caused by the abrupt dropping of the heavy buffer spring load while there is still some flux in the relay, the remedy is to remove the buffer spring, if this can be done.

Rebound

Rebound is the bounce of the armature after it hits the backstop on release. On wire spring relays with a short armature travel, all the contacts may close at about the same time leaving no contact safe from rebound, if it occurs. On intermediate travel relays the late contacts are usually safe from closure on rebound.

The make contacts of continuity (EMB) springs are vulnerable to rebound on relays with intermediate travel. Where such springs are used to lock a relay, the locking circuit should not be re-enabled for at least 20 msec after the relay has released in order that rebound will not cause the relay to lock falsely. This condition can sometimes be overcome by the use of a long travel relay whose preliminary contacts may absorb the rebound. Rebound can also be reduced by the use of a minimum 60-gram armature back tension. A flexible mounting, P-19A890, can also be used to aid in reducing rebound, especially under pulsing conditions.

Rebound is aggravated by operation under a pulsing condition, a release from a short pulse closure and the use of a shunt, contact protector, or sleeve. Table I-1 summarizes the results of a study of rebound on the wire spring relay with contact protection but no sleeve or shunt. It shows that relays with light spring loads (two to six contacts) should be free from rebound, except possibly under pulsing conditions. Rebound chatter increases with the use of the long armature, the number of springs, and an increase in the armature travel.

TABLE I-1

ESTIMATE OF OCCURRENCE AND DURATION OF CONTACT OPERATION DUE TO REBOUND

Relay Type	Arm. Travel	No. of Contact Spring Pairs	Length of False Operation
AF	Short	2 to 18	None
AF	Int	2 to 6	None
AF	Int	7 to 18	0 to 2
AJ	Short	2 to 6	None
AJ	Short	7 to 18	0 to 3
AJ	Short	19 to 24	1 to 4
AJ	Int	2 to 6	0 to 1
AJ	Int	7 to 18	0 to 4
AJ*	Int	19 to 24	2 to 6

*May have two or three false operations.

Long travel relays are not included in Table I-1. They are worse than the intermediate travel relays. Lightly-loaded long travel relays may be liable to false closure of the preliminary contacts; heavily-loaded relays may close both the preliminary and the early contacts.

Rebound is negligible on the AK relay if either half of the relay is operated or released while the other half of the rèlay is stationary. If both halves are released together, or within 50 msec of each other, rebound chatter may occur.

Short Pulse Operation

The contacts of a relay can be caused to function on a pulse of current shorter than the actual operate time of the relay. This effect is due to the armature inertia and is aggravated by the use of a contact protection network. The actual operate time of a relay operating from a short pulse is longer than its operate time on a long steady closure.

Under the worst conditions, short travel mass-controlled wire spring relays may operate on a pulse equal to about 50 percent of their actual operate time if protected by a 186A network, 60 percent if protected by a 185A network, and 70 percent if unprotected. When the back tension is increased, the armature travel or the contact gap tends to make the length of the pulse required to operate the relay approach the normal operate time.

Similarly, an interruption of the coil current, much shorter than the release time of the relay, may permit the armature to fall away from the core and open some of the closed contacts. In extreme cases, with no contact protection, an interruption of current as short as 40 percent of the release time can release the relay. With contact protection the open interval to release the relay would vary from 50 to 75 percent of the normal release time depending on the contact protection and relay coil.

Grounding Strap

The wire spring relay is usually insulated from the mounting plate, but it is sometimes necessary to ground the relay core for shielding reasons in high-frequency circuits. A grounding strap, P-15A868, which is assembled in the relay behind the mounting bracket, has been developed for this purpose. It must be specified as part of the relay code.