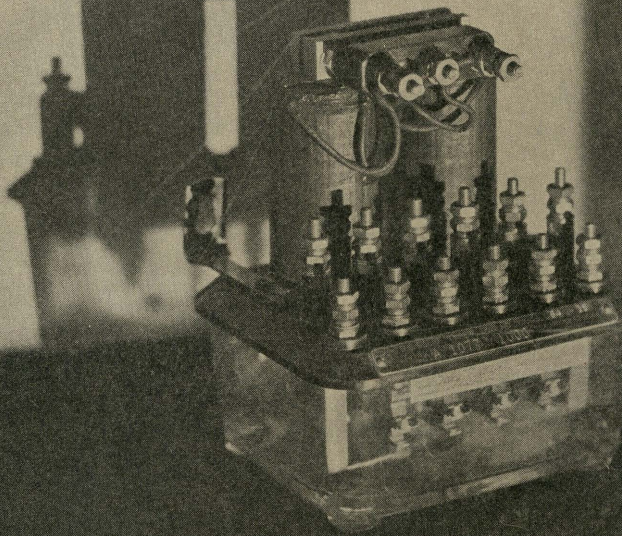
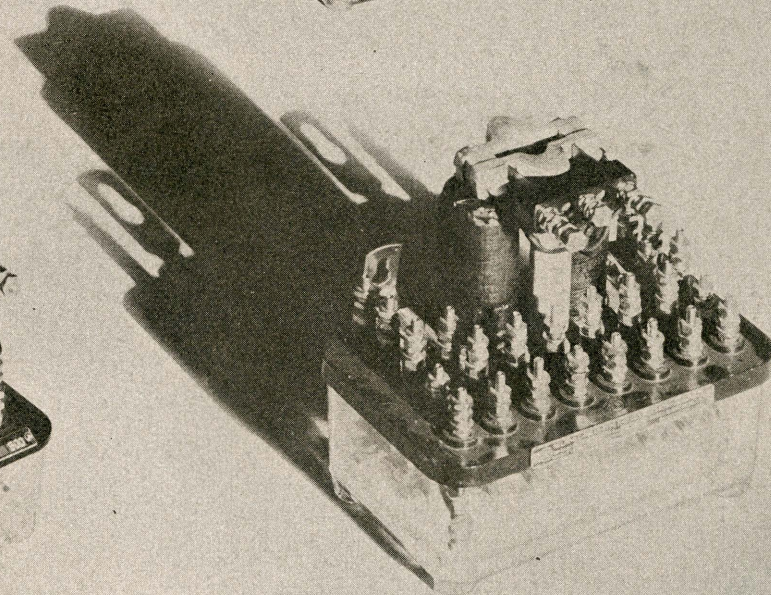
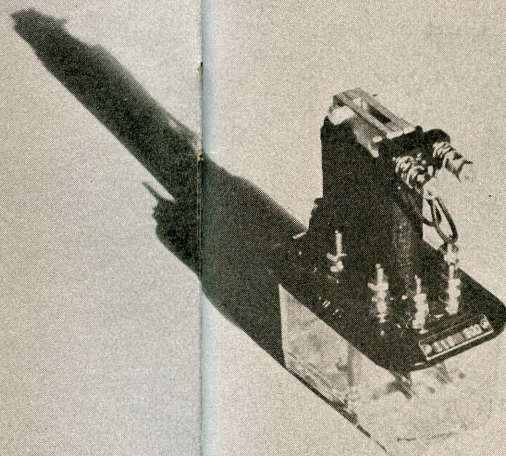
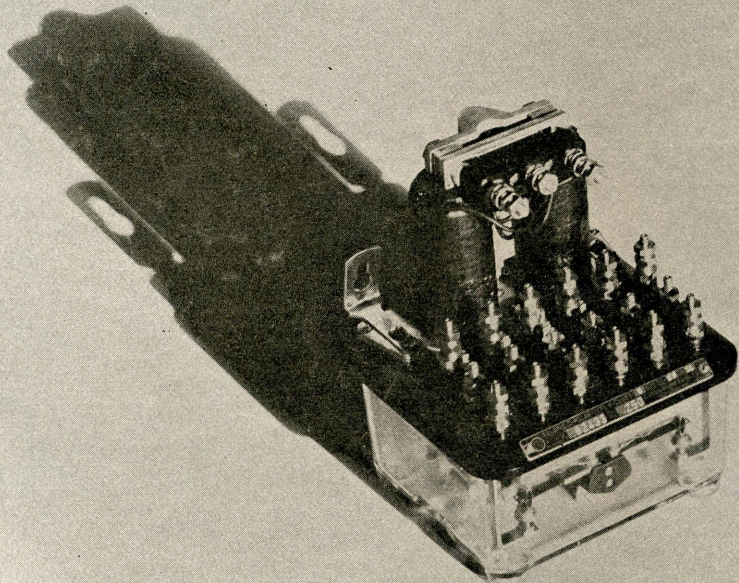
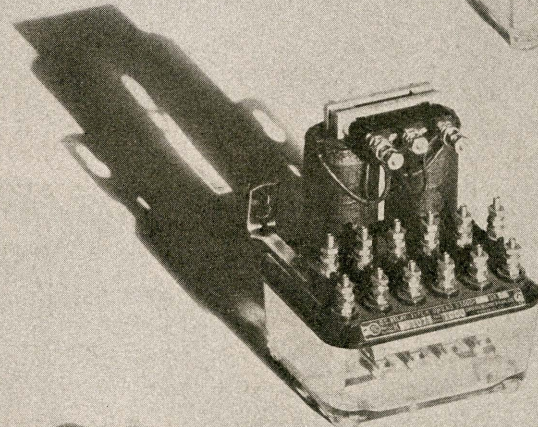
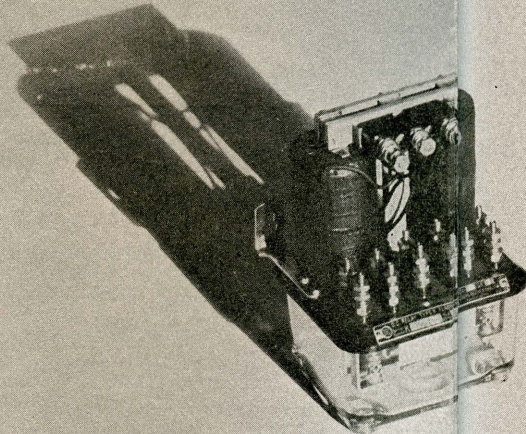
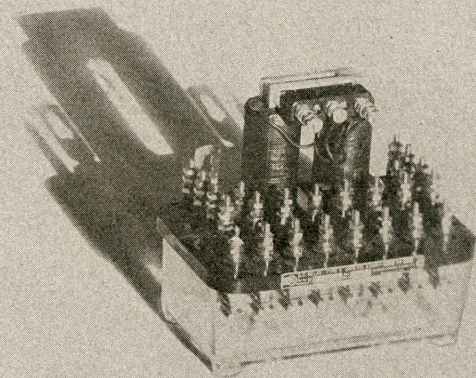
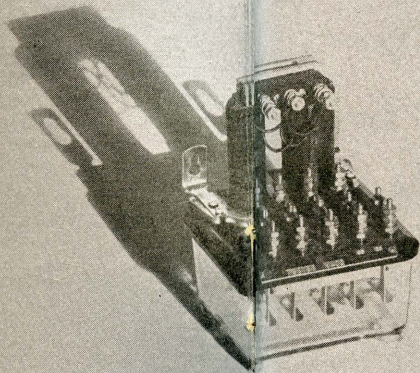
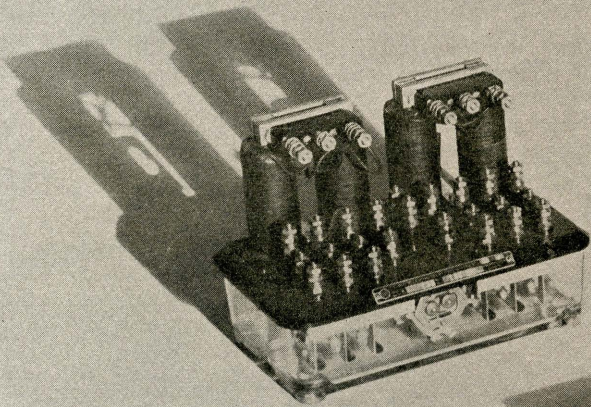


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Bulletin 162

Type K Relays



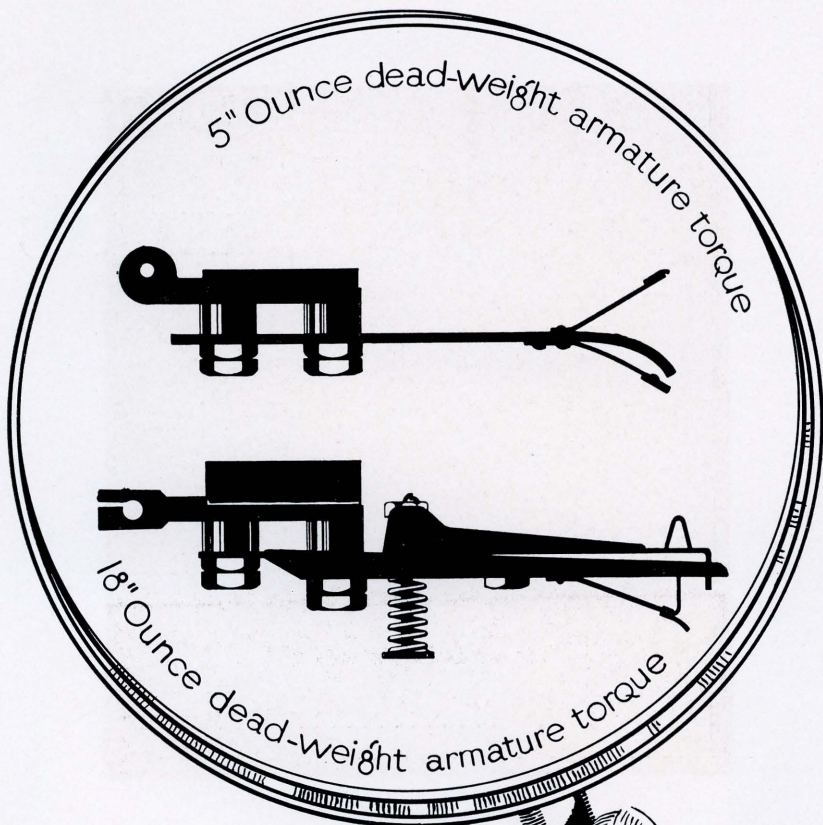
G = R = S
TYPE K
RELAYS



GENERAL RAILWAY SIGNAL COMPANY
A UNIT OF GENERAL SIGNAL

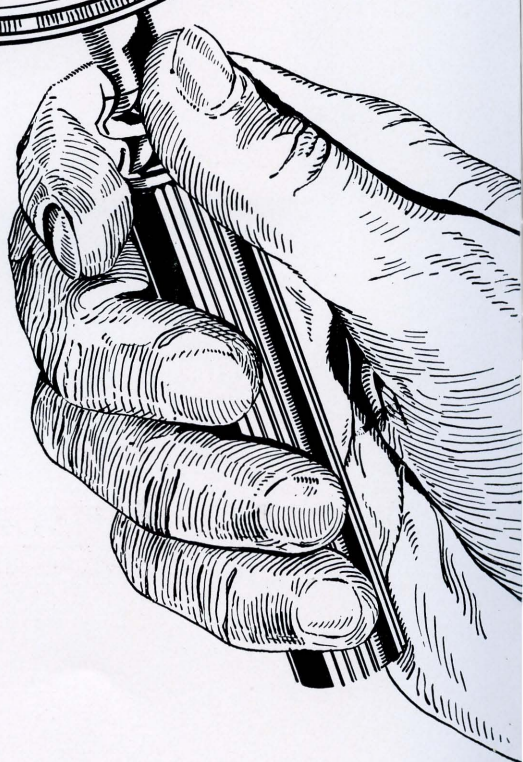
ROBERT B. HIO
DISTRICT MANAGER

UNITED CALIFORNIA BANK BUILDING SUITE 915
1330 BROADWAY OAKLAND CA 94612 415 • 893-3100



THE Type K Relay has an armature weight equivalent to an 18 inch-ounce mechanical torque. A. R. A. Specifications call for 5 inch-ounces. 3.6 times greater is the K Relay torque.

That is why K Relays have a back-contact pressure equal to their front-contact pressure. It means low back-contact resistance; a positive drop-away; dependable operation under adverse operating conditions.



G = R = S
TYPE K
RELAYS

BULLETIN 162

AUGUST 1931



GENERAL RAILWAY SIGNAL COMPANY

ROCHESTER, N. Y., U. S. A.

CONTENTS

The Type K Line

Neutral	Sizes 2, 4, 6, and 8
Polarized	Sizes 6 and 8
Retained-Neutral Polarized	Sizes 6 and 8
Interlocking	Size 8
Flashing	Size 4

Other Relays for D. C. Signaling

Type W Relay, Class A
Type W Relay, Class B
Type W Relay, Class E
Type T Thermal Relay, Class A
Type T Thermal Relay, Class B

Table of Contents

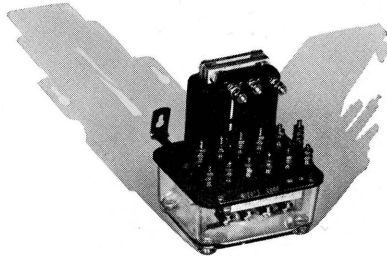
	Page
Modern Relays	5
Type K Neutral Relays	15
Type K Neutral Relay, Size Two	16
Type K Neutral Relay, Size Four	20
Type K Neutral Relay, Size Six	22
Type K Neutral Relay, Size Eight	24
Type K Polarized Relays	27
Type K Polarized Relay, Size Six	28
Type K Polarized Relay, Size Eight	30
Type K Retained-Neutral Polarized Relays	33
Type K Interlocking Relay	38
Type K Flashing Relay	44
Type W Relay, Class A	48
Type W Relay, Class B	53
Type W Relay, Class E	56
Type T Thermal Relay, Class A	58
Type T Thermal Relay, Class B	60

Modern Relays

MODERN relays are efficient, economical, dependable, and retain their superior operating characteristics over a long period of years. In a word, they are relays of such high quality and superior performance that their use has been largely responsible for the recent fundamental changes that are taking place in modern signaling and interlocking practices.

G-R-S Direct Current Type K Relays are, in the strictest sense, the most modern and highly developed line of D. C. Relays available to the railroads to date. They are economical in first cost because of efficient quantity production, and economical in operation because of the long service they render at a low energy consumption.

Modern signaling is dependent upon such relays. Systems of Train Operation by Signal Indications such as G-R-S Centralized Traffic Control place absolute dependence on relay performance. They are the heart of such systems. They check the integrity of the route. They prevent the possibility of operators' mistakes in the manipulation of levers and check the manipulation. They are more and more supplementing the time-honored and dependable function of mechanical locking between levers and electric lever locks. This "relay locking" and "automatic control" is largely the result of modern relays. Such relays are safeguarding and making dependable an increasing number of signaling devices and systems.



G-R-S Type K Relays

THE Line of Type K Relays consists of ten D. C. Relays and is complete in that these ten relays answer all usual requirements of signaling and interlocking circuits where direct current is used for their operation. However, the Line does not include such special D. C. Relays as: Thermal, Power-off, and small Series Relays, all of which have special characteristics and a relatively narrow application. A brief description of these special relays will be found beginning on page 49 under "Other G-R-S Relays for D. C. Signaling."

Type K Relays are grouped in five general classes, viz:

Neutral	Sizes 2, 4, 6, and 8
Polarized	Sizes 6 and 8
Retained-Neutral Polarized	Sizes 6 and 8
Interlocking	Size 8
Flashing	Size 4

Type K Neutral Relays cover the broad field requiring standard D. C. Neutral Relays. One of these is a small relay designed to fill the requirements where quick shunting is essential or where only one or two contacts are required.

Type K Polarized Relays provide polar contact operation as positive, efficient, and dependable as the contact operation of Type K Neutral Relays. Four neutral contacts and either two or four dependent polar contacts provide ample contacts for any of the usual applications of polarized relays.

Type K Retained-Neutral Polarized Relays eliminate the necessity for using slow release repeater relays which function to keep control circuits over neutral contacts closed during polar contact operation.

Type K Interlocking Relays utilize a recently developed and extremely simple interlocking mechanism. They have operating characteristics similar to Type K Neutral Relays.

Type K Flashing Relays provide a means for operating flashing-light highway crossing signals. They have a large contact capacity.

As previously mentioned, this Line covers all usual requirements for direct current signaling. An extremely wide range of resistances are available, as well as numerous contact combinations and two different kinds of contact materials as will be described in detail later.

Design

SUPERFICIALLY, a direct current relay is little more than a coil, a piece of iron, an armature, and a few contacts. For years, such a device as this operated contacts quite satisfactorily for the usual signaling requirements, but not with any degree of efficiency, and sometimes without reliability.

In designing Type K Relays, a complete review of the relay situation was made; and past performances, as well as present and future requirements, carefully considered. Since the problem was to produce a device that would adequately operate a signal system by controlling it through the medium of contacts, the whole relay was therefore designed around the contact.

The articulated contact fingers developed for Type K Relays insure positive contact pressure being indefinitely maintained, and overcome the difficulty experienced in the past because of the flat contact springs fatiguing in service.

Heavier armatures were designed principally to increase the dead-weight armature torque and thus overcome back contact resistance troubles.

To take care of these requirements and to increase operating efficiencies, cores and yokes of large cross-sectional area are provided. The cores are set well apart so as to bring the pole-

pieces close to the ends of the armature; thus making it very simple to set the armature parallel to the pole-faces. The extra space between the cores also reduces the magnetic flux leakage; thereby increasing the efficiency of the relay.

Type K Relays are designed so that many of the parts used in the various models are interchangeable. The neutral magnetic structures are identical, and neutral armature set-ups are the same on all standard Type K Relays. Whether the relay has a resistance of 2 or 2,000 ohms; whether it is quick, regular, or slow-acting, it can be converted from one to the other without making any internal adjustments whatever, and the operating values will be correct. For example, a 4 ohm relay may be converted to a 500 ohm relay by simply changing the coils. A regular-releasing relay may be changed to a quick-releasing relay by simply removing one of the yokes. A regular-releasing relay may be changed to a slow-releasing relay by simply substituting the proper coils and placing copper washers on one of the cores.

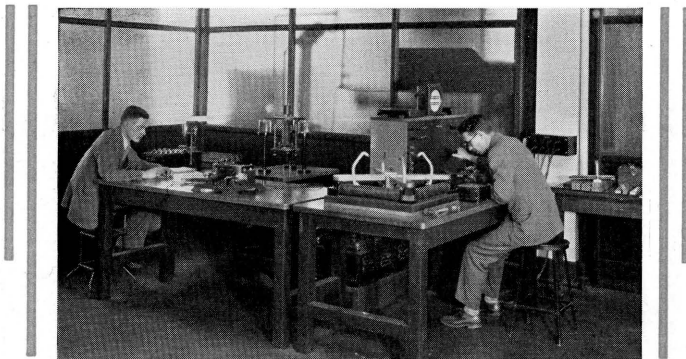


Figure 1. A section of the G-R-S Research Laboratories showing development work being carried on in connection with the magnetic materials used in Type K Relays.

Material Facts

SUPERIOR materials, skillfully treated, go into the making of Type K Relays.

One of the most interesting, as well as probably the most important, is that used in the magnetic structure. Special analysis steel treated by the most modern methods, as developed in the G-R-S Research Laboratories, has resulted in the relay cores, armature, and yoke having magnetic characteristics far superior to any materials formerly used for these parts, and assures characteristics which remain unchanged throughout many years of continuous service. The treating of this steel is also controlled by recently developed methods so that the exact characteristics desired are always obtained.

Another example of how the intelligent use of superior materials results in the extensive application of Type K Relays in the field of modern signaling is the material used to make Universal Contacts. These contacts are an exclusive G-R-S development, and their use reduces contact troubles to an absolute minimum.

A special bronze is used in the terminal posts of Type K Relays. This material, which has just recently been made avail-

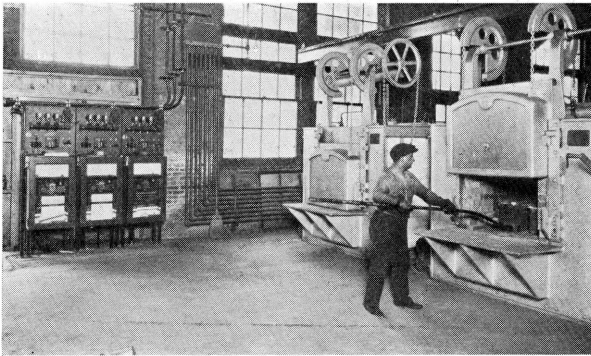


Figure 2. Electric furnace used in heat-treating steel.

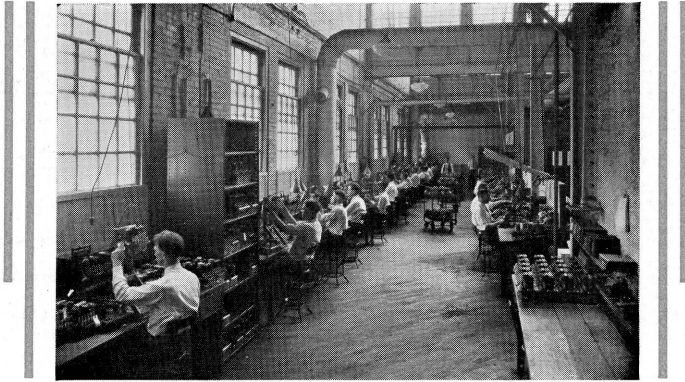


Figure 3. Type K Relays undergo a rigid inspection and test.

able, is almost as strong as steel and has great corrosion-resisting properties.

Unusual care is exercised, from the selection of the raw materials to the testing of the finished Type K Relay, in order to insure long life and dependable service.

The Articulated Contact Finger

The Articulated Contact Finger is generally conceded to be one of the most outstanding developments in years.

All Type K Relays are equipped with neutral contact fingers of this type. This finger, as the name implies, consists of two rigid parts which are accurately but flexibly connected to each other. The first part is secured to the armature, while the second part is flexibly held in the proper position, relative to the first, through the medium of a ball and socket joint and a small, non-fatiguing, spiral, bronze spring. The second

part carries the contact. The ball joint permits the contact to roll and find its seat accurately; thereby insuring equal pressure over the entire contact area, as well as maintaining this area, while the spiral spring insures the maintenance of this pressure indefinitely in service. In flat spring contact fingers, the pressure gradually decreases to zero as the contact breaks and, if vibration is present, contacts arc and pit; whereas, with articulated fingers there is a material pressure maintained up to the instant of breaking, thus insuring a clean, positive break.

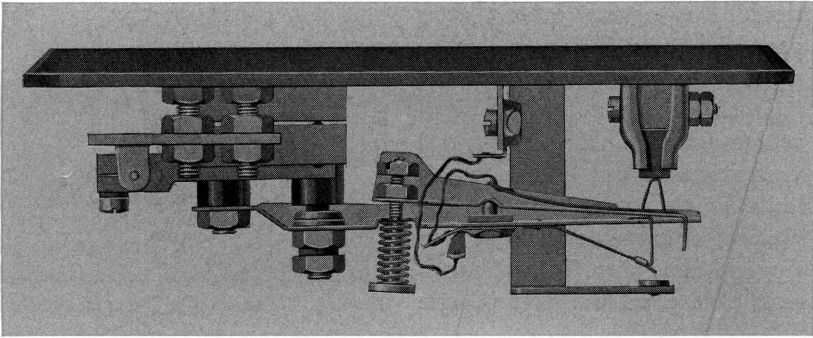


Figure 4. Detail construction of the Articulated Contact Finger with relay energized.

Drooping characteristics found in previous contacts, due to fingers taking a set, are eliminated in articulated fingers.

Contacts

As the design of a relay naturally develops around the contact, and because contact operation is the ultimate purpose of a relay, great effort has been expended in an attempt to improve this all-important detail.

The first notable improvement was the G-R-S Silver Gauze to Carbon contact. Not fully content with this achievement, work was continued which resulted in the "Universal" contact making its appearance.

Universal Contacts

Universal Contacts are an exclusive development of the G-R-S Research Laboratories and have only been available during the past two years.

In Universal Contacts, relay builders have realized a long-sought aim; that is, to obtain a material with the characteristics of carbon for taking an arc when the circuit is broken and yet have the low-resistance characteristic of silver for carrying the load. The Universal Contact will

carry 3 amperes continuously and will interrupt this current regardless of how inductive the load may be, at either low or high voltage. (A.R. A. 1st and 2nd range voltages.)

This contact is always mounted on an Articulated Finger, as shown in Figure 5 and is the contact furnished with all Type K Relays unless otherwise specified.

Exhaustive tests have indicated that the combination of materials used in Universal Contacts will give

trouble-free service over a long period of years. This was demonstrated by accelerated life tests during which the contacts were operated several million times in breaking various inductive and non-inductive loads, as well as operating in the presence of corrosive fumes at high degrees of humidity. These life tests more than equal the most adverse

operating conditions that could be expected in years of service.

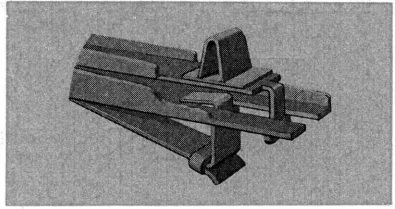


Figure 5. Close-up of a Universal Contact.

Silver Gauze Contacts

Silver Gauze contacts, Figure 6, have been in very general use for a number of years, and consist of a specially woven silver gauze operating in conjunction with a special grade of carbon. This contact combination is practically non-fusible, and is very uniform in its resistance characteristics. Their operating resistance in the field is about ten or eleven thousandths of an ohm.

can be furnished instead of Universal contacts with all Type K Relays except the Flashing Relay.

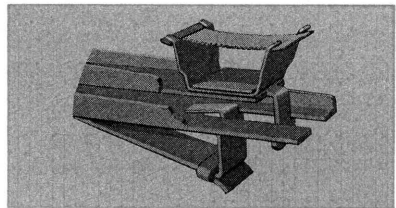


Figure 6. Close-up of a Silver Gauze Contact.

General Features of the Type K Line

Neat Appearance

ALL TYPE K Relays, regardless of the size, are neat, attractive, and similar in appearance. In addition they are comparatively small in size, easy to install, and are dust and moisture-proof. Each size is equipped with a one-piece, heavy, moulded-glass cover to obtain good visibility of all enclosed parts.

Shelf or Wall Mounting

Wall mounting shock-absorbing brackets, Figure 7, are standard equipment on all models with the exception of the small Type K Relay, Size 2, which is supplied with a special base suitable for wall or shelf mounting. This base is shown in Figure 10. The larger Type K Relays have a separate coil-spring base, Figure 8, for shelf mounting. At locations where relays are subjected to severe vibration, special brackets similar to those shown in Figure 9 are recommended for wall mounting.

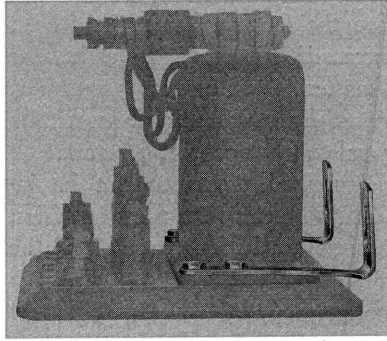


Figure 7. Wall Mounting Shock-absorbing Brackets.

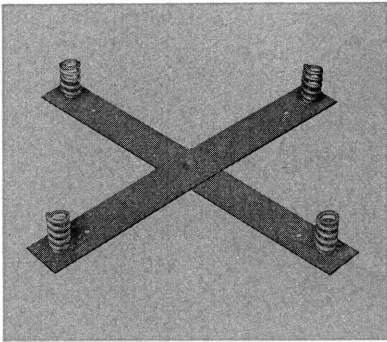


Figure 8. Shelf Mounting Shock-absorbing Base.

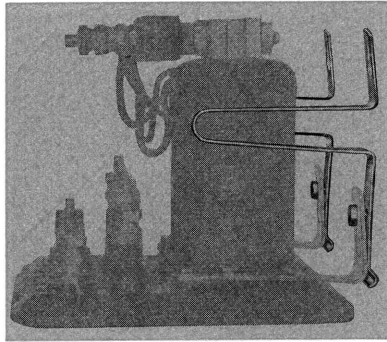


Figure 9. Special Shock-absorbing Brackets.

Few Parts

An important feature is the comparatively few parts used in making Type K Relays. Many of these parts are interchangeable for all models, with the result that manufacturing

costs are materially reduced, the stock of repair parts carried by the railroads is small, and better relays are produced.

Increased Efficiency and Savings

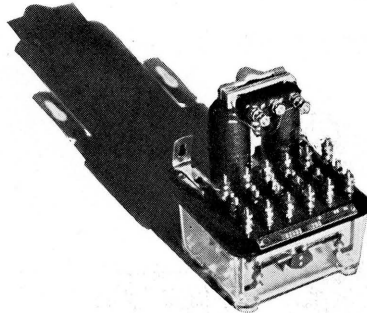
The drop-away torque and therefore the factor of safety has been increased by providing a heavier armature. Back contact pressure is materially increased and practically equal to front contact pressure.

Increased resistance can be inserted in series with track batteries, circuits can be lengthened, and the

safety of track circuit operation increased.

High operating values are maintained indefinitely; therefore shopping and inspection costs are reduced.

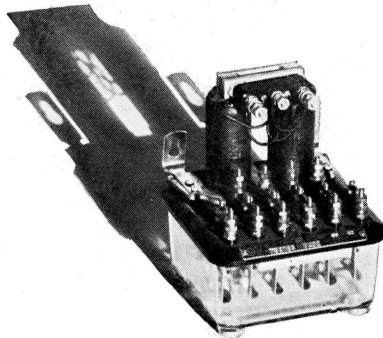
In a word, the installation of Type K Relays, whether for replacement or for new work, means increased savings.



Type K Neutral Relays

THE group of G-R-S direct current Type K Relays presented in the following pages is believed to be complete for nearly every direct current signaling need. The General Railway Signal Company is proud to introduce this complete line of relays to the signaling profession. They are high efficiency relays manufactured by modern methods. They are extremely simple in design. And, many parts are interchangeable. Because of production methods in our factory, the value received for the original purchase price is high. Their long life, satisfactory service, and great energy savings provide even greater savings as time passes.

A detailed description of the four Type K Neutral Relays will be found in the following pages:



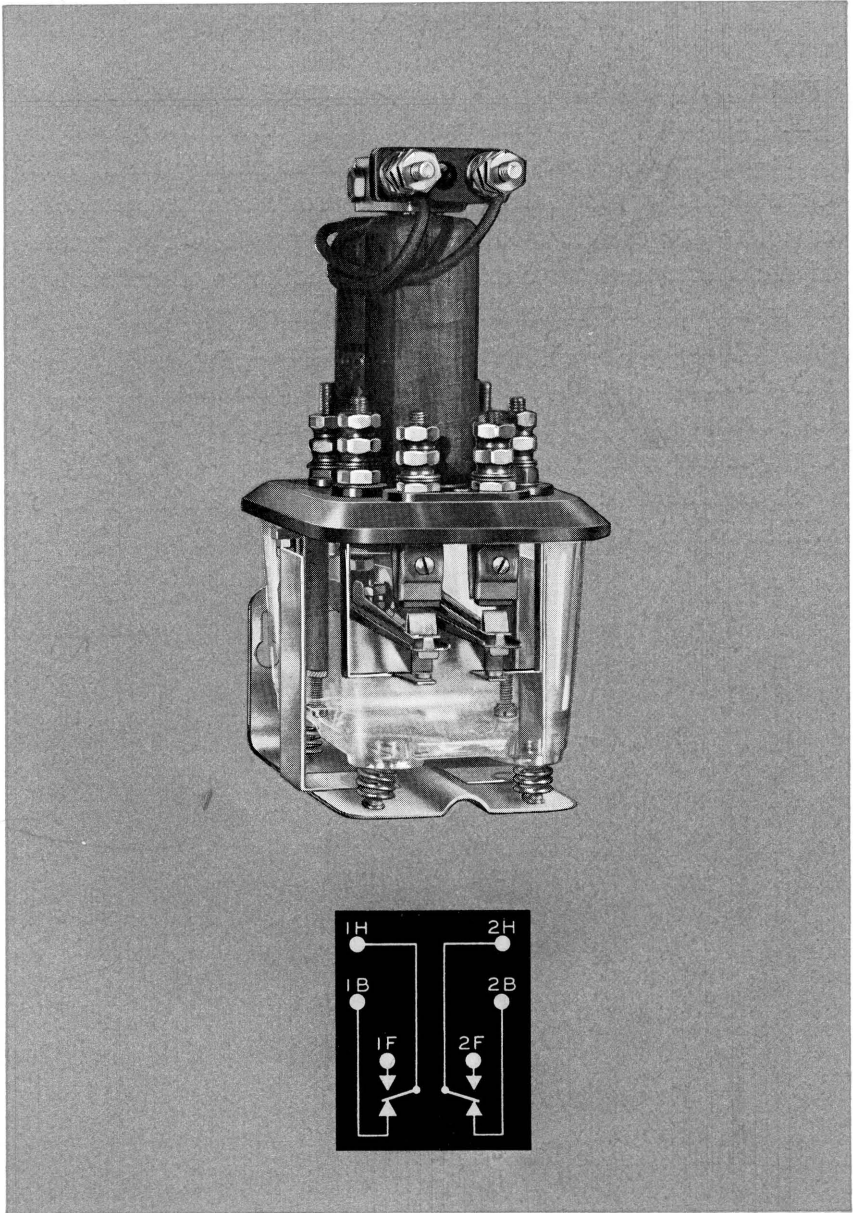


Figure 10. The Type K Neutral Relay, Size Two, and its Terminal Arrangement.

Type K Neutral Relay, Size Two

THE Type K Neutral Relay, Size Two, has the special characteristic of being quick shunting. It will shunt in approximately 0.3 second under service conditions, which is materially quicker than the shunting time of most modern relays.

This relay, Figure 10, is built with the same exacting care and of the same high grade materials used in standard Type K Relays, the essential difference being that fewer contacts are operated; thus allowing smaller coils and a smaller magnetic structure for its operation.

Application

Track relays having the quick shunting characteristic of this relay are desirable at interlocking plants, especially if there are fast moves of light equipment such as light engines, gas-electric cars, etc. Without a quick shunting relay, or other means, there is a possibility of an electric locking circuit being momentarily released. It is always desirable

to have a track relay shunt before the train has progressed very far on to the track circuit, and this is particularly true if the track circuit is short.

The Size Two Relay is ideal for use as a track relay at interlockings where the practise is to do all circuit selection through track relay repeaters located in the tower, since

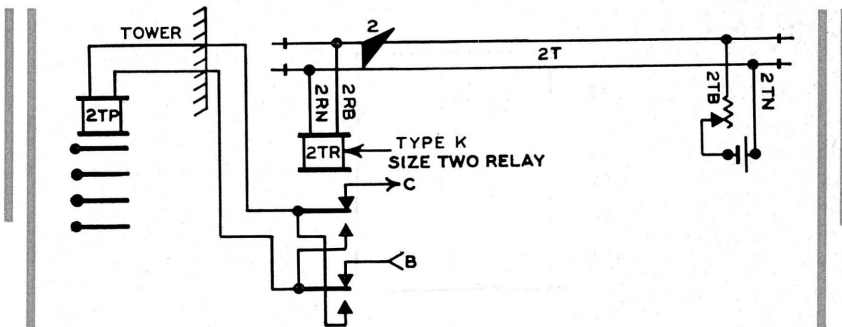


Figure 11. The Size Two Relay used to control a repeater in the tower for "SS" control.

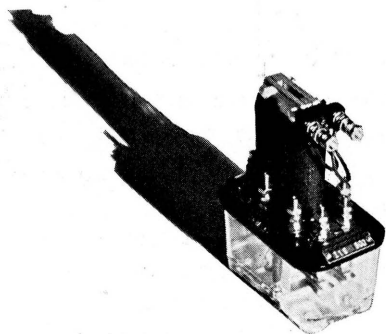
only one or two contacts are required on the track relay. Type K Neutral Relays, having the required number of contacts and desired operating

characteristics, may then be used as repeaters.

The circuit in Figure 11 illustrates this application.

Detail Information
Type K Neutral Relay, Size Two

- Contacts:** Two front and back dependent contacts as shown in Figure 10.
Universal or Silver Gauze. Usual front contact opening, 0.050"; for breaking high voltage circuits, 0.090".
- Resistance:** 2, 3, 4, 7, 9, 11, 16, 25, 40, 50, 60, 100, 150, 200, 300, 400, 500, 600, 750, and 800 ohms.
- Operation:** Quick shunting track relay. Regular, slow-releasing, or slow-pickup as desired for a line relay.
- Operating Values:** For a 4 ohm relay; values for other resistances on this ampere turn base:
Working Current, Max. - - - - - 0.070 amp.
Pickup Current, Max. - - - - - 0.070 amp.
Release Current, Min. - - - - - 0.040 amp.
- Overall Dimensions:** Height $7\frac{9}{16}$ ", Width $3\frac{7}{8}$ ", Depth $6\frac{1}{4}$ ".
- When Ordering:** See our Catalog E, Vol. 1, Part 21, Plate E 2105. Specify 1st or 2nd range contact opening.



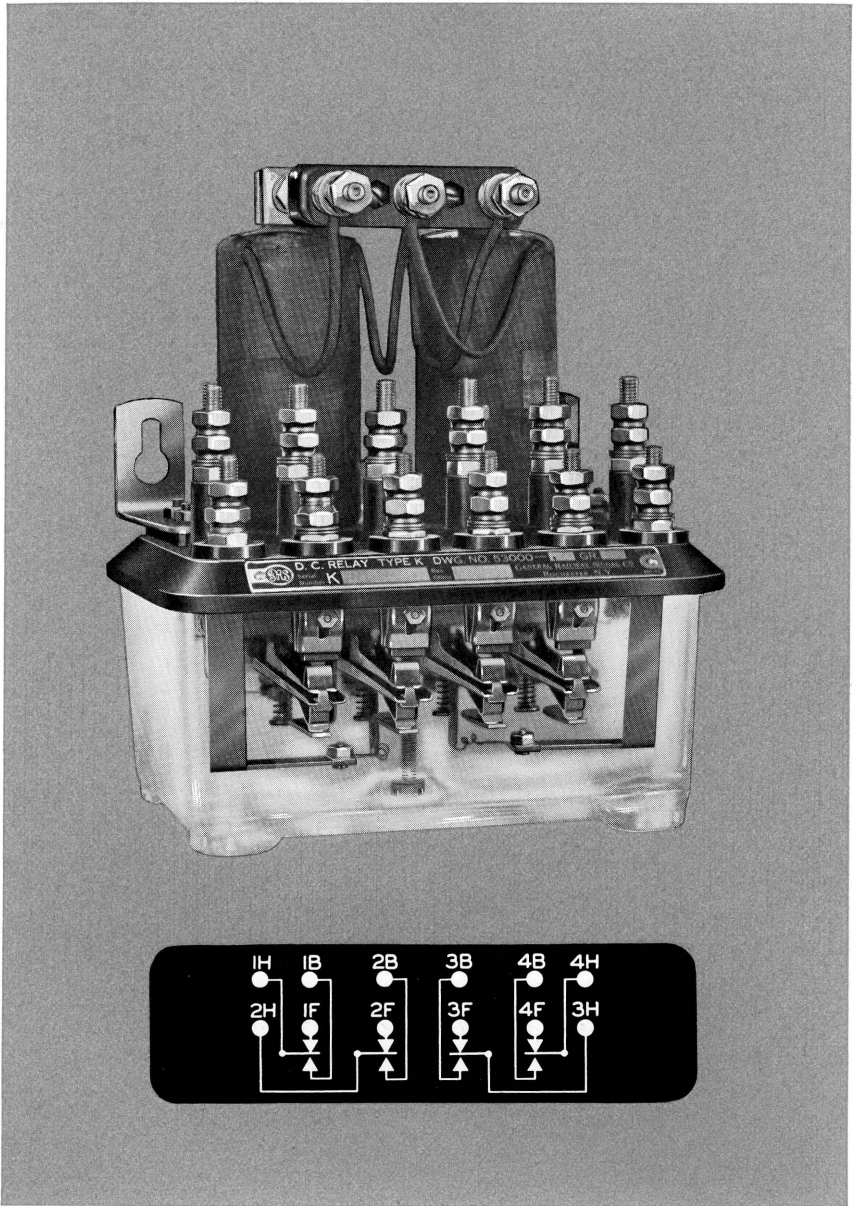


Figure 12. The Type K Neutral Relay, Size Four, and its Terminal Arrangement.

Type K Neutral Relay, Size Four

THIS relay, Figure 12, was the first of the Type K Line to be developed. It is the most popular and widely used of all signaling relays.

It has extremely good operating values and is universal in application, being ideal for either track or line use. It is this relay that is being furnished in large quantities to replace old relays on the justifiable basis of energy savings alone.

Detail Information

Type K Neutral Relay, Size Four

Contacts: Four front and back dependent contacts as shown in Figure 12.

Universal or Silver Gauze. Usual front contact opening, 0.050"; for breaking high voltage circuits, 0.090".

Resistance: 2, 4, 11, 16, 50, 100, 136, 150, 200, 250, 300, 400, 450, 500, 670, 750, 1,000, 2,000, and 10,400 ohms for regular-releasing relay.

25, 50, 68, 75, 100, 125, 150, 200, 225, 250, 335, 375, 400, 500, 800, and 1,000 ohms for slow-releasing relay.

Operation: Regular, slow-release, or slow-pickup as desired.

Operating Values: For a 4 ohm relay; values for other resistances on this ampere turn base:

Working Current, Max. - - - - - 0.070 amp.

Pickup Current, Max. - - - - - 0.070 amp.

Release Current, Min. - - - - - 0.037 amp.

Overall Dimensions: Height $8\frac{5}{8}$ ", Width $7\frac{3}{8}$ ", Depth $6\frac{3}{8}$ ".

When Ordering: See our Catalog E, Vol. 1, Part 21, Plate E 2109.
Specify 1st or 2nd range contact opening.

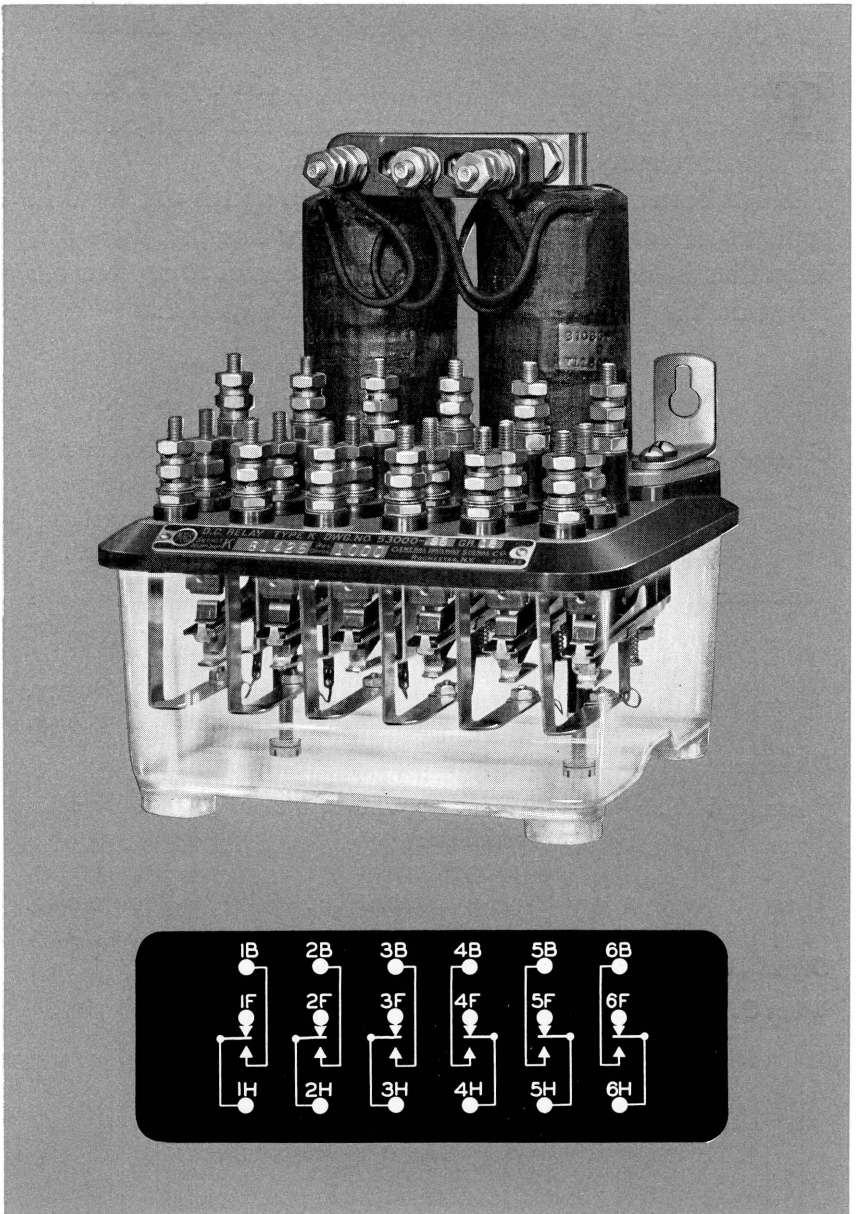


Figure 13. The Type K Neutral Relay, Size Six, and its Terminal Arrangement.

Type K Neutral Relay, Size Six

THIS relay, Figure 13, is exactly the same as the Size Four, except that it has a larger number of contacts. This necessitates slightly higher operating values; however, the increase is so slight that the installation of this relay is warranted in practically every case where this number of contacts is required.

The majority of roads prefer to use Size Two or Size Four track relays and repeater relays if more contacts are required.

Detail Information

Type K Neutral Relay, Size Six

- Contacts:** Six front and back dependent contacts as shown in Figure 13.
Universal or Silver Gauze. Usual front contact opening, 0.050"; for breaking high voltage circuits, 0.090".
- Resistance:** 2, 4, 11, 16, 50, 100, 136, 150, 200, 250, 300, 400, 450, 500, 670, 750, 1,000, 2,000, and 8,400 ohms for regular-releasing relay.
25, 50, 68, 75, 100, 125, 150, 200, 225, 250, 335, 375, 400, 500, 800, and 1,000 ohms for slow-releasing relay.
- Operation:** Regular, slow-release, or slow-pickup as desired.
- Operating Values:** For a 4 ohm relay; values for other resistances on this ampere turn base:
Working Current, Max. - - - - - 0.088 amp.
Pickup Current, Max. - - - - - 0.088 amp.
Release Current, Min. - - - - - 0.044 amp.
- Overall Dimensions:** Height $9\frac{1}{8}$ ", Width $7\frac{11}{16}$ ", Depth $7\frac{9}{16}$ ".
- When Ordering:** See our Catalog E, Vol. 1, Part 2I, Plate E 2113. Specify 1st or 2nd range contact opening.

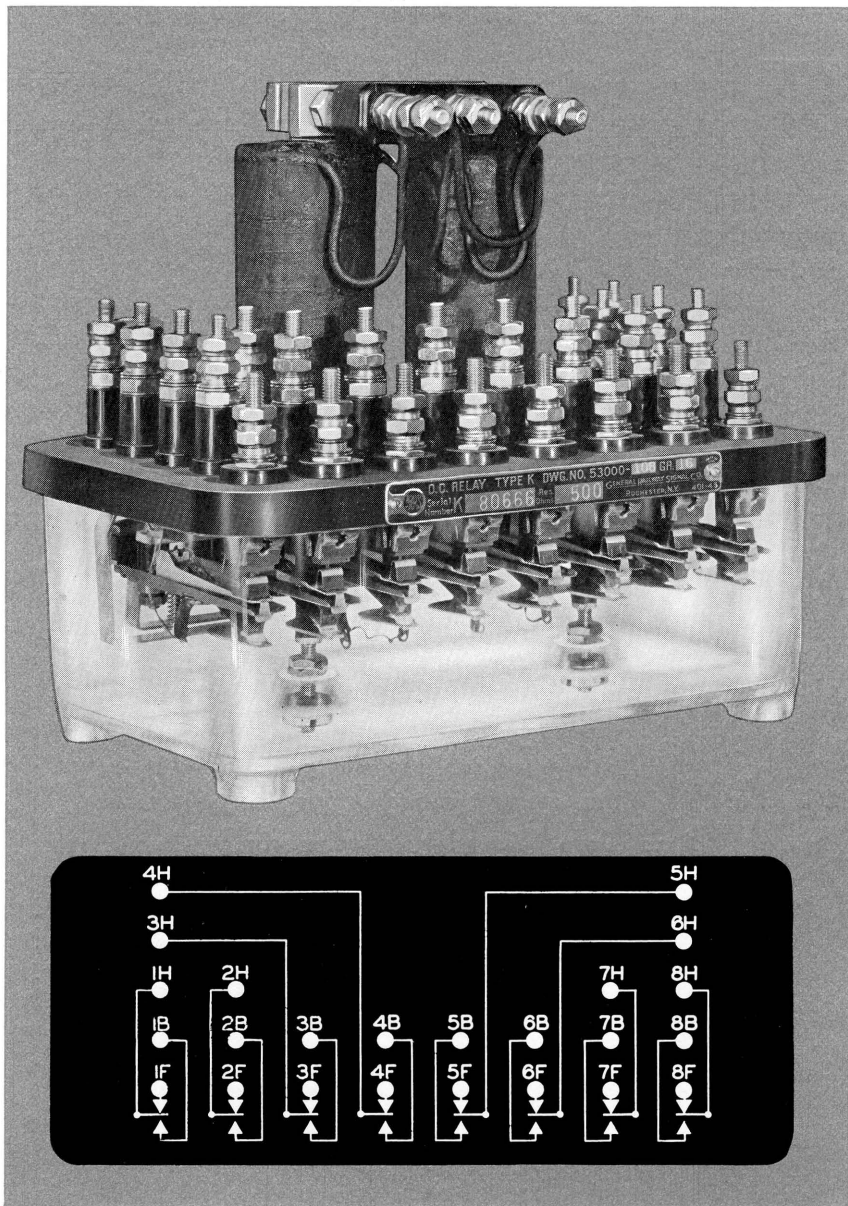


Figure 14. The Type K Neutral Relay, Size Eight, and its Terminal Arrangement.

Type K Neutral Relay, Size Eight

THIS relay, Figure 14, is becoming increasingly popular as a line relay where a large number of contacts is required. It is economical of space and often eliminates an extra relay. This relay is also economical in operation, having operating values only slightly higher than a Size Four Relay.

Detail Information

Type K Neutral Relay, Size Eight

Contacts: Eight front and back dependent contacts as shown in Figure 14.

Universal or Silver Gauze. Usual front contact opening, 0.050"; for breaking high voltage circuits, 0.090".

Resistance: 2, 4, 11, 16, 50, 100, 136, 150, 200, 250, 300, 400, 450, 500, 670, 750, 1,000, and 2,000 ohms.

Operation: Regular, slow-release, or slow-pickup as desired.

Operating Values: For a 4 ohm relay; values for other resistances on this ampere turn base:

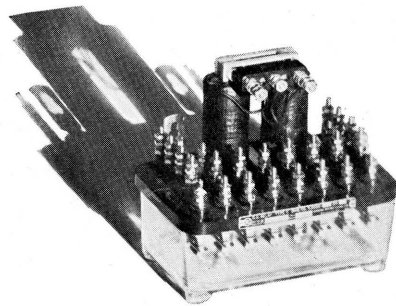
Working Current, Max. - - - - - 0.099 amp.

Pickup Current, Max. - - - - - 0.099 amp.

Release Current, Min. - - - - - 0.045 amp.

Overall Dimensions: Height $9\frac{1}{8}$ ", Width $10\frac{1}{8}$ ", Depth $6\frac{5}{8}$ ".

When Ordering: See our Catalog E, Vol. 1, Part 21, Plate E 2117. Specify 1st or 2nd range contact opening.



Type K Polarized Relays

POLARIZED relays have become increasingly popular during the last few years largely as the result of modern signaling requirements and the availability of improved types of these relays. Type K Polarized Relays have a number of superior features not obtainable before their advent and are playing no small part in the progressive development taking place in signaling today.

In Type K Polarized Relays the operation of the polar contacts has been made as positive and dependable in every way as the operation of neutral contacts. This is a fact of great importance and is a long desired accomplishment.

The Magnetic Structure

Figure 15 shows two views of the magnetic structure and illustrates the path of the magnetic flux in both neutral and polar structures with the relay poled both normal and reverse.

The polar functions are incorpo-

rated in the neutral functions in such a way that there is no appreciable loss in the torque applied to the neutral armature, because a perfect flux balance exists between the two functions at all times.

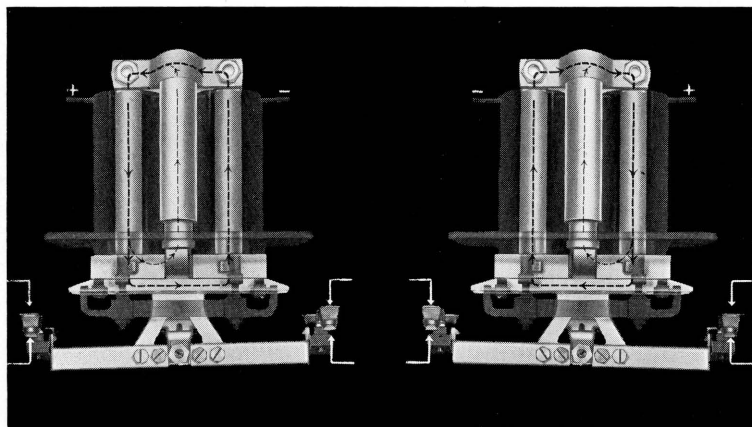


Figure 15. The Magnetic Structure of the Type K Polarized Relay.

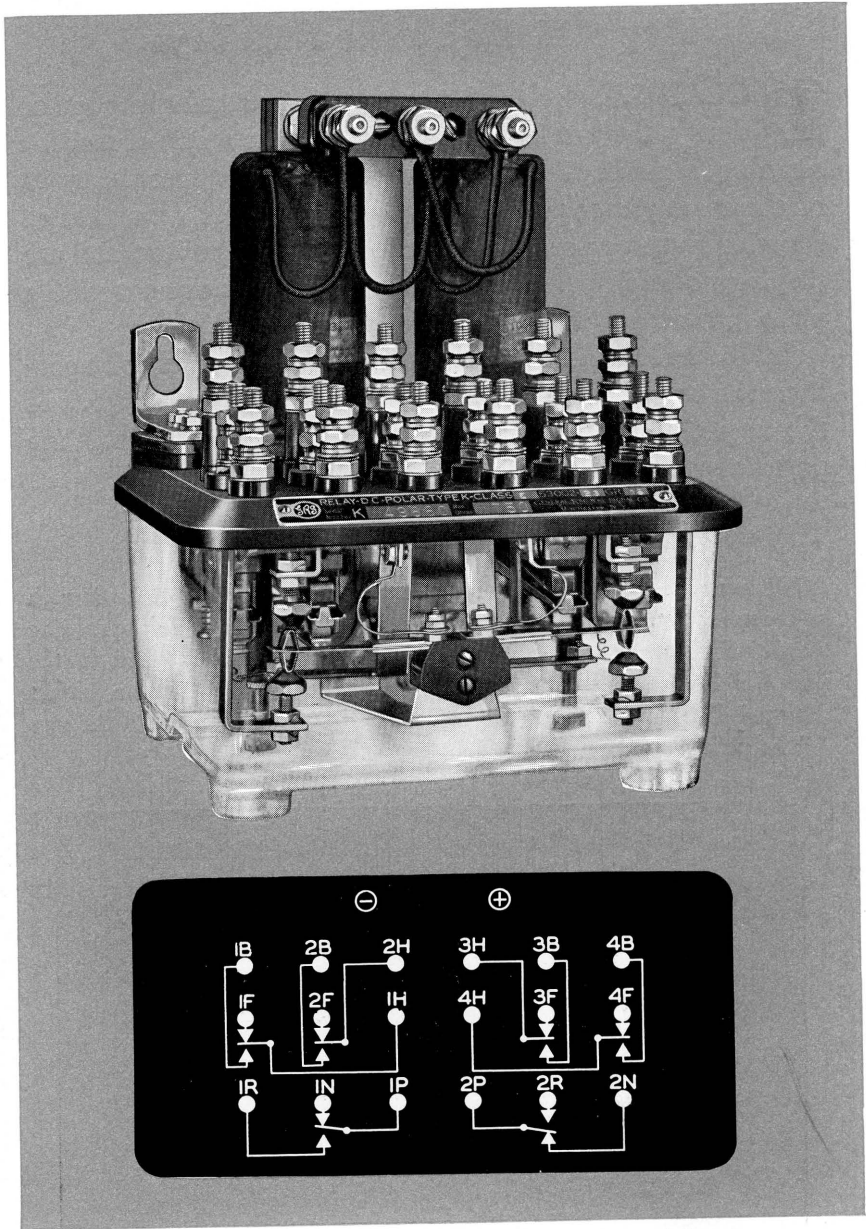


Figure 16. The Type K Polarized Relay, Size Six, and its Terminal Arrangement.

This design and the use of materials having superior magnetic properties greatly increases the efficiency, permits the use of a heavier polar structure, and assures more positive polar contact operation.

Operation

The polar armature operates positively at a current value much below the pickup of the neutral armature; thereby assuring positive reversal of the polar contacts before the neutral armature picks up.

Polar contact pressure equal to

neutral contact pressure assures low and uniform contact resistance.

There are no vertical trunnion bearings in the Type K Polarized Relay because the polar contacts operate in a vertical plane the same as the neutral contacts.

Type K Polarized Relay, Size Six

THIS relay, Figure 16, is the size generally used in A.P.B. Signaling for polarized line circuits and in \overline{AT} for polarized line and polarized track circuits. It is the most popular size and has slightly better operating values than the larger Size Eight Relay.

Detail Information

Type K Polarized Relay, Size Six

Contacts:	Four front and back dependent neutral contacts and two normal and reverse dependent polar contacts as shown in Figure 16. Universal or Silver Gauze. Usual front contact opening, 0.050"; for breaking high voltage circuits, 0.090".
Resistance:	2, 4, 7, 11, 16, 50, 100, 136, 150, 200, 250, 300, 400, 450, 670, 750, 1,000, 2,000, and 10,400 ohms for regular relay.
Operation:	Regular, slow-release, or slow-pickup as desired.
Operating Values:	For a 4 ohm relay; values for other resistances on this ampere turn base:

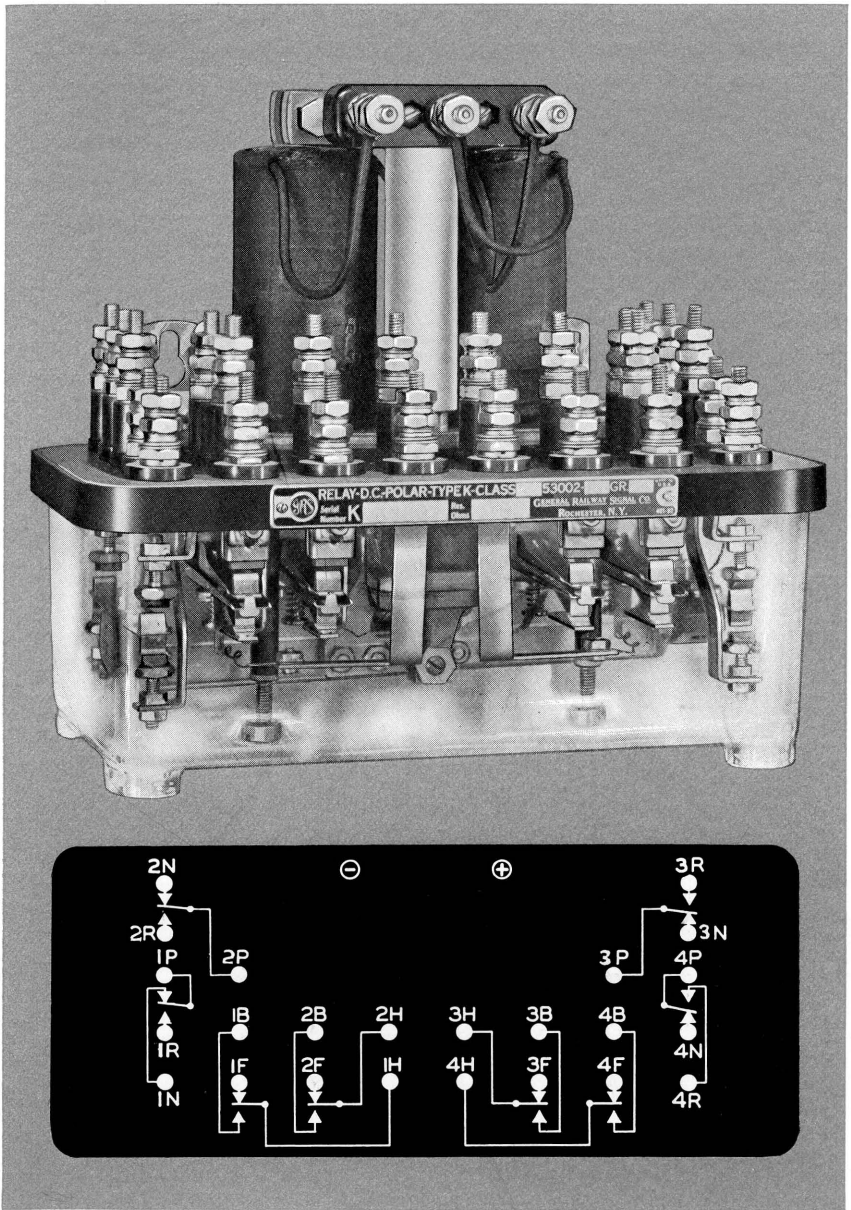


Figure 17. The Type K Polarized Relay, Size Eight, and its Terminal Arrangement.

Normal Working Current, Max. - - - - -	0.075 amp.
Normal Pickup Current, Max. - - - - -	0.075 amp.
Reverse Working Current, Max. - - - - -	0.080 amp.
Reverse Pickup Current, Max. - - - - -	0.080 amp.
Release Current, Min. - - - - -	0.040 amp.
Polar Working Current, Max. - - - - -	0.060 amp.
Polar Pickup Current, Max. - - - - -	0.060 amp.

Overall Dimensions: Height 9 $\frac{1}{8}$ " , Width 7 $\frac{11}{16}$ " , Depth 7 $\frac{9}{16}$ " .

When Ordering: See our Catalog E, Vol. 1, Part 22, Plate E 2201.
Specify 1st or 2nd range contact opening.

Type K Polarized Relay, Size Eight

THIS relay, Figure 17, is compact in size and attractive in appearance. While it has slightly higher operating values than the Size Six Relay, it is being used wherever a greater number of contacts is required than that obtainable in the Size Six.

Its most extensive application is probably as a switch repeater relay at interlocking plants where "SS" control is used.

In this application, Figure 18, the fact that it has a large number of contacts often eliminates the necessity for normal and reverse repeaters for repeating the polarized WP relay positions.

The Size Eight Relay is also being used extensively in A.P.B.

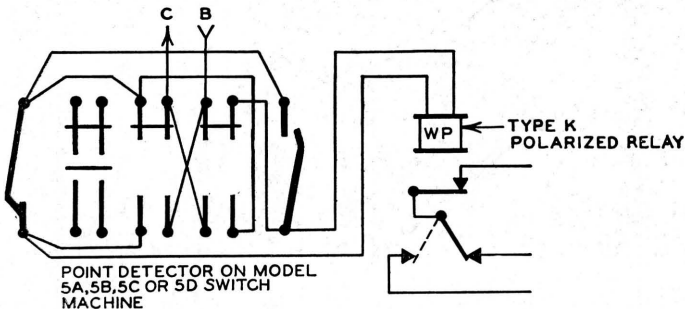


Figure 18. A polarized switch repeater circuit.

and $\overline{a}a$ circuits where polar contacts are used to pole-change other circuits.

Detail Information

Type K Polarized Relay, Size Eight

Contacts: Four front and back dependent neutral contacts and four normal and reverse dependent polar contacts as shown in Figure 17.

Universal or Silver Gauze. Usual front contact opening, 0.050"; for breaking high voltage circuits, 0.090".

Resistance: 2, 4, 11, 16, 50, 100, 136, 150, 200, 250, 300, 400, 450, 500, 670, 750, and 1,000 ohms.

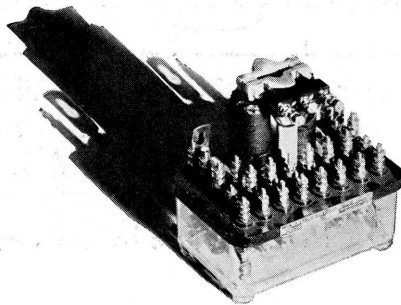
Operation: Regular, slow-release, or slow-pickup as desired.

Operating Values: For a 4 ohm relay; values for other resistances on this ampere turn base:

Normal Working Current, Max. - - - - -	0.097 amp.
Normal Pickup Current, Max. - - - - -	0.097 amp.
Reverse Working Current, Max. - - - - -	0.107 amp.
Reverse Pickup Current, Max. - - - - -	0.107 amp.
Release Current, Min. - - - - -	0.044 amp.

Overall Dimensions: Height $9\frac{1}{8}$ ", Width $10\frac{1}{8}$ ", Depth $6\frac{5}{8}$ ".

When Ordering: See our Catalog E, Vol. 1, Part 22, Plate E 2205
Specify 1st or 2nd range contact opening.



Type K Retained-Neutral Polarized Relay

AS THE name indicates, this newly developed polarized relay, Figures 20 and 22, has a neutral armature that does not momentarily release during the reversal of current in its operating coils, provided the operating current is pole-changed by a relay or any other device having an equivalent speed of operation.

In addition, this Retained-Neutral feature is effective as long as there is enough current flowing in the coils to operate the neutral armature. The neutral armature is retained in its energized position during polar contact operation by an electromagnetic induction method without the aid of mechanical or ordinary slow-release devices.

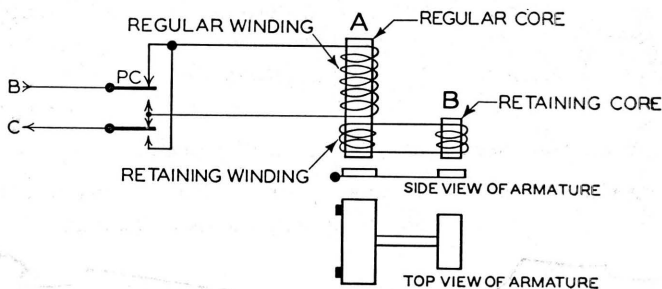


Figure 19. Principle of operation of the Retained-Neutral Polarized Relay.

Figure 19 illustrates the operation of this relay. "A" represents the main operating coils that are similar in appearance and location to the usual relay coils, while "B" represents an auxiliary set of small coils which are located on the extreme front of the relay. These retaining coils act on a small armature which is attached to the main armature by a non-magnetic extension.

Since the two windings at "A" are interwound, a voltage is induced in the retaining winding at "A" when the operating

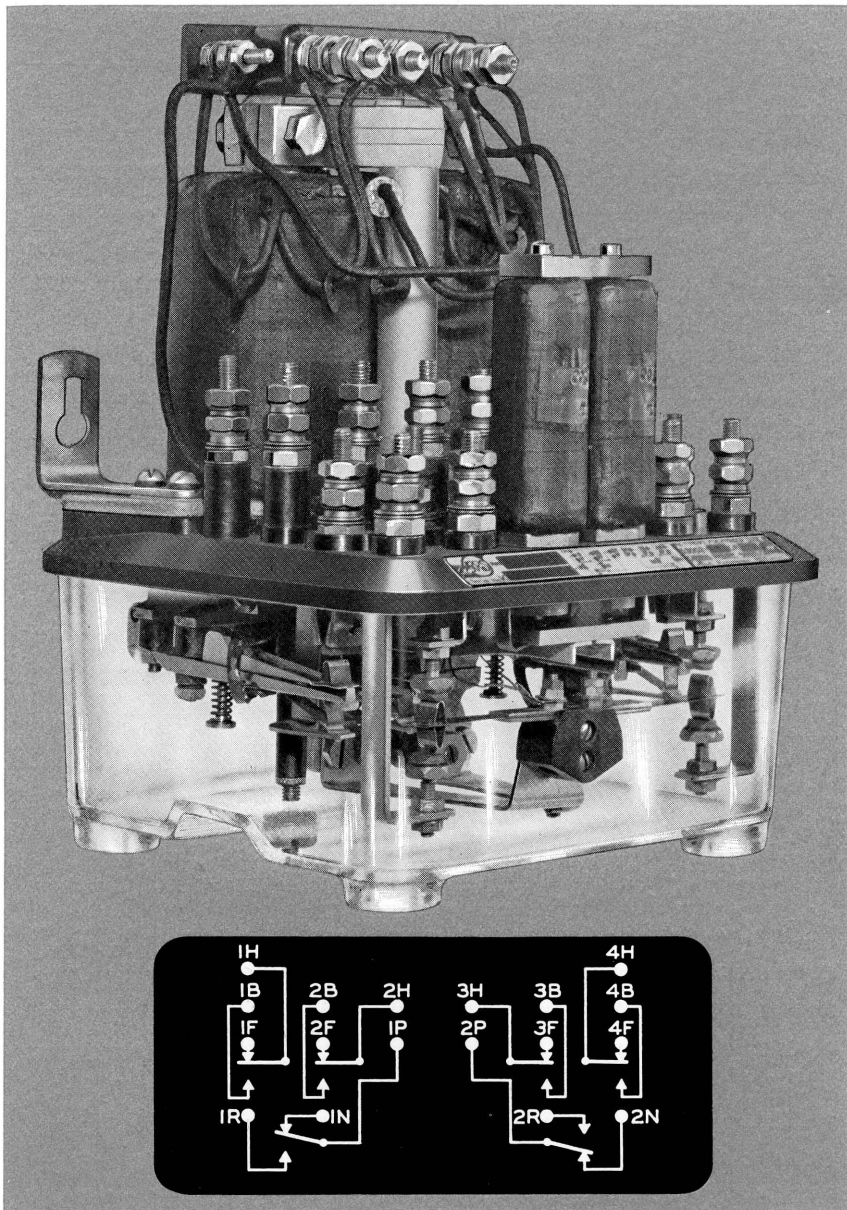


Figure 20. The Type K Retained-Neutral Polarized Relay, Size Six, and its Terminal Arrangement.

current is reversed in the main winding. This voltage impressed on the coil "B" causes current to flow through it and produce a magnetic flux in the retaining core.

The net result is that the armature extension is made to hold the armature up during the reversal of flux in the main core.

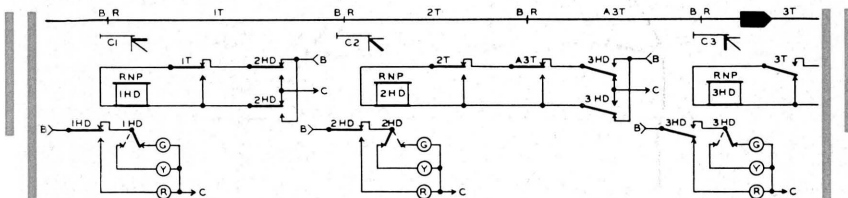


Figure 21. Simplified polarized line circuits for double-track signaling using Type K Retained-Neutral Polarized Relays.

Application

It is a well known fact that the neutral contacts of an ordinary polarized relay open momentarily during the operation of the polar contacts. Consequently, a slow-release relay, repeating the operation of the neutral contacts, must be used when circuits over the neutral contacts are to be maintained closed during polar contact operation.

Under these circumstances, the use of a Type K Retained-Neutral Polarized Relay will often eliminate the slow-release relay.

Figure 21 shows the essentials for

one track of a simple double track color-light signaling system. With Type K Retained-Neutral Polarized Relays there can be no red signal flash when the signal indication is changing from yellow to green or vice versa. In addition, there can be no progressive operation of the relays set up due to the operation of one of them. In other words, there can be no blinking or momentary tumbling-down of a number of successive signals as would happen if ordinary polarized relays were used in the circuits of Figure 21.

Detail Information

Type K Retained-Neutral Polarized Relay, Size Six

Contacts:

Four front and back dependent neutral contacts and two normal and reverse dependent polar contacts as shown in Figure 20.

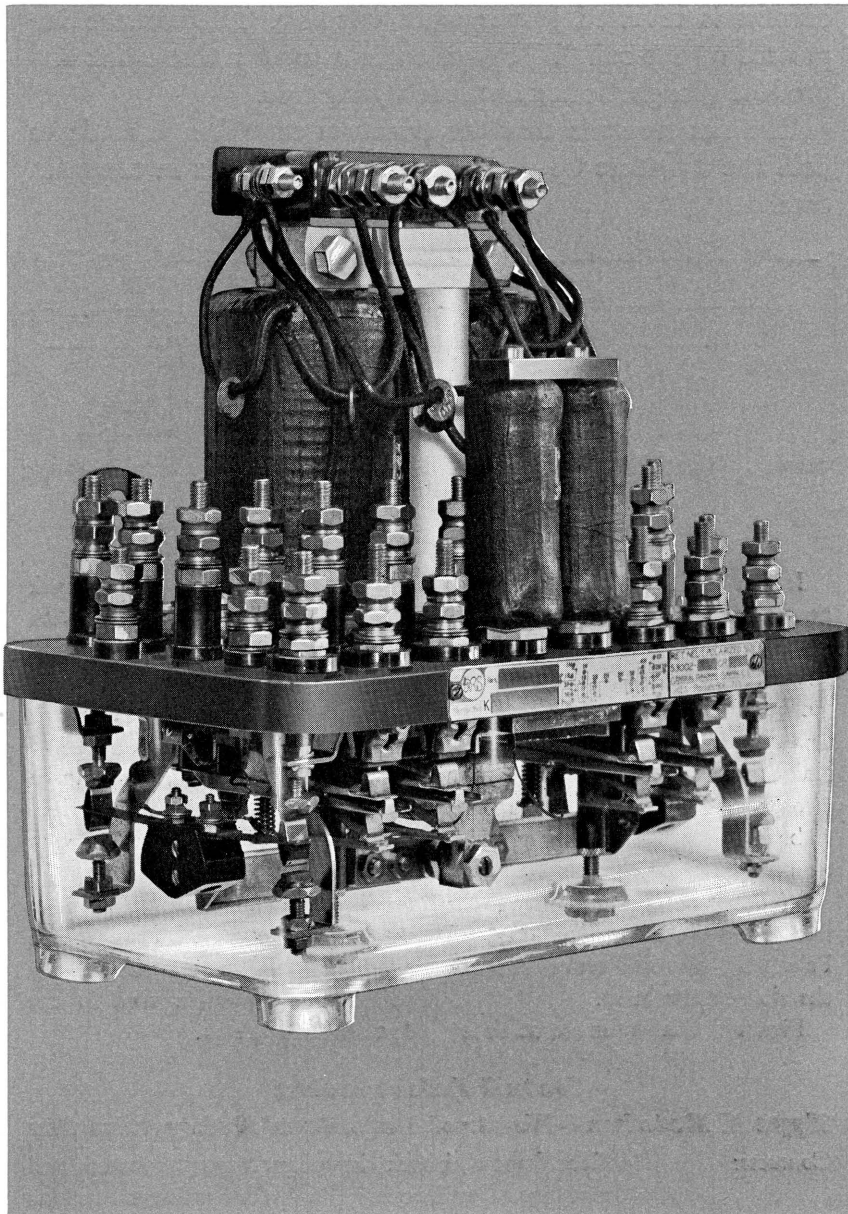


Figure 22. The Type K Retained-Neutral Polarized Relay, Size Eight.

Contacts: Regularly equipped with Universal Contacts.

Overall Dimensions: Height $10\frac{1}{16}$ " , Width $7\frac{11}{16}$ " , Depth $7\frac{9}{16}$ " .

When Ordering: Give details concerning service requirements.

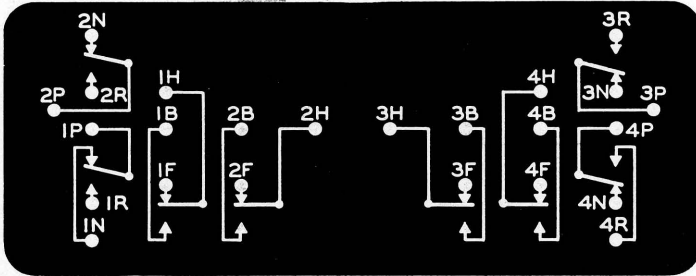


Figure 23. Terminal Arrangement of the Type K Retained-Neutral Polarized Relay, Size Eight.

Detail Information

Type K Retained-Neutral Polarized Relay, Size Eight

Contacts: Four front and back dependent neutral contacts and four normal and reverse dependent polar contacts as shown in Figure 23.

Regularly equipped with Universal Contacts.

Overall Dimensions: Height $10\frac{1}{16}$ " , Width $10\frac{1}{8}$ " , Depth $6\frac{5}{8}$ " .

When Ordering: Give details concerning service requirements.

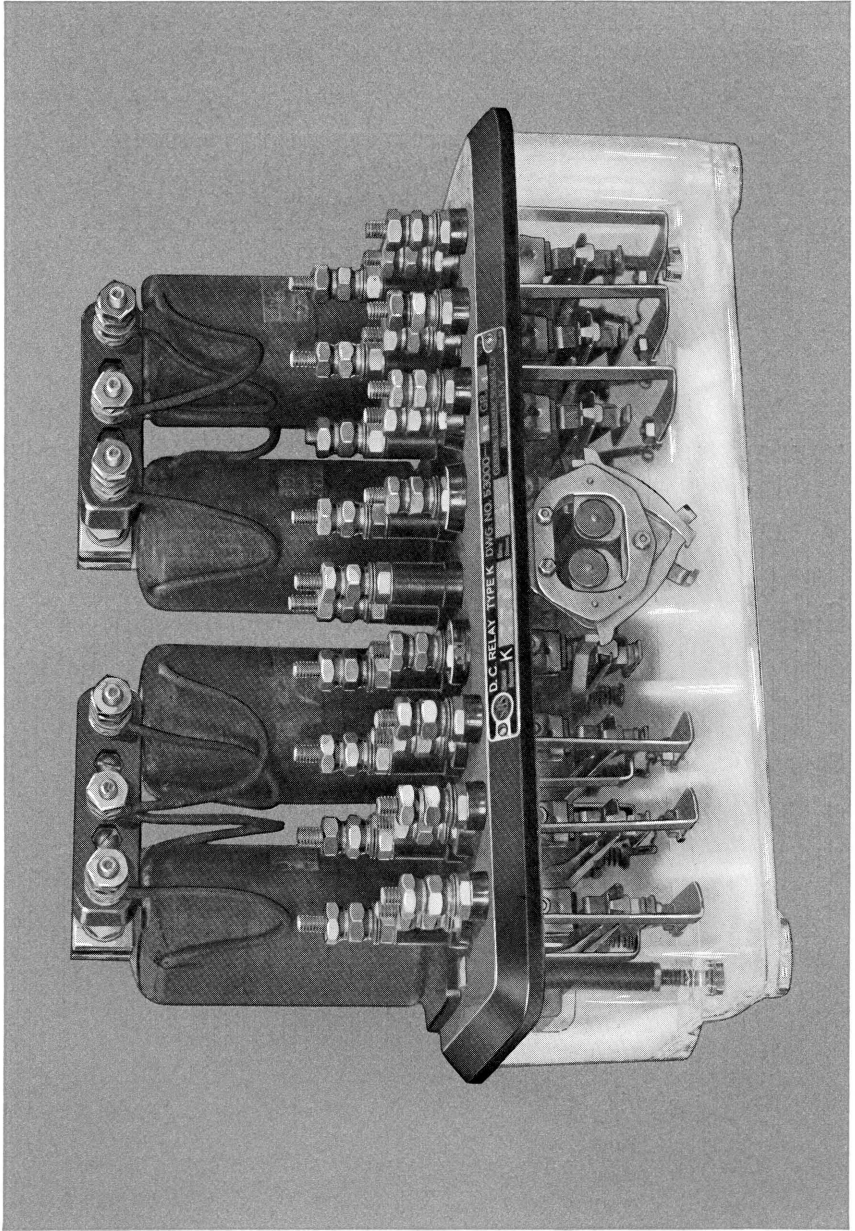


Figure 24. The Type K Interlocking Relay.

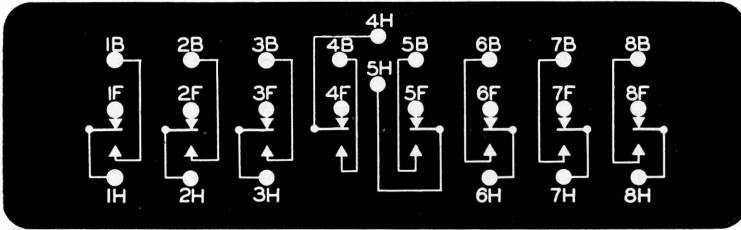


Figure 25. Terminal Arrangement of the Type K Interlocking Relay.

Type K Interlocking Relay

INTERLOCKING relays have gone through a course of development along with many other signaling devices and the modern Type K Interlocking Relay should not be compared, in any way, with those on the market a few years ago. This Interlocking Relay is being employed by many engineers in many new ways to simplify circuit design.

The Type K Interlocking Relay, Figure 24, consists essentially of two Type K Neutral Relays, Size Four, mounted side by side on the same base with the interlocking device incorporated in the design.

The big feature of this relay is that it makes available an interlocking relay having the salient features and improved operating values characteristic of the Type K Line.

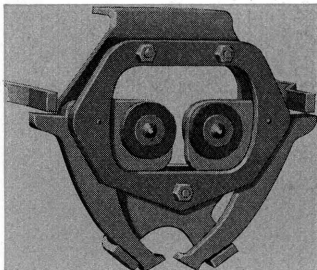


Figure 26. Close-up of Interlocking Mechanism showing its simplicity.

Interlocking Mechanism

Another important feature of this relay is the recently developed and extremely simple interlocking mechanism, a close-up of which is shown in Figure 26. The operation of this simple device is made possible through the large dead-weight armature torque available in Type K Relays.

The sequence of operation of this interlocking mechanism with a train moving

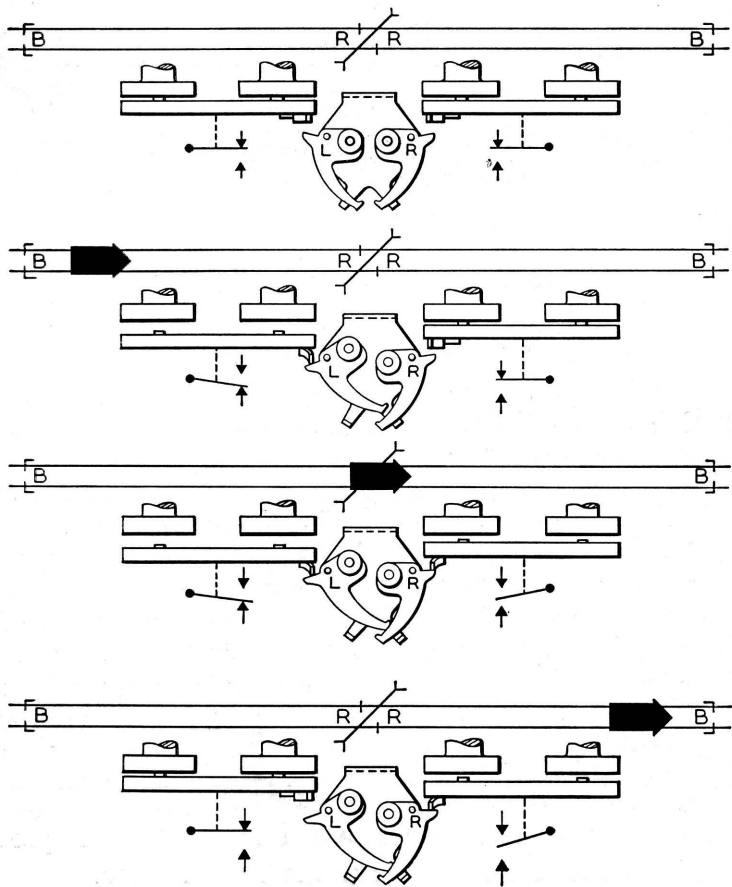


Figure 27. Sequence of operation of the Interlocking Mechanism as a train moves from West to East.

progressively over the track circuits is illustrated in Figure 27. It should be noted that in every case it is simply the weight of the armature hold-

ing one of the pawls against the other that accomplishes the interlocking which holds one armature in its intermediate position.

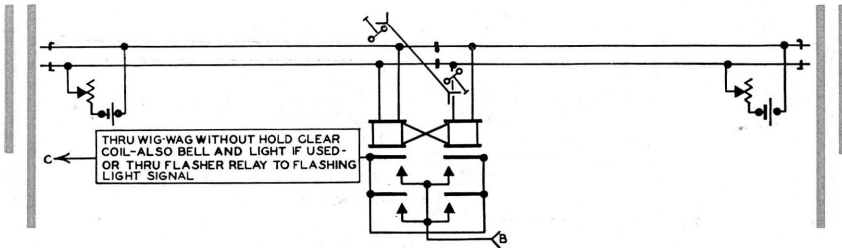


Figure 28. Application of a Type K Interlocking Relay with contacts that are open in the locked position.

Application

Although we usually think of interlocking relays in connection with highway crossing signals, they have many interesting and varied applications. Their use often simplifies circuit design and it is believed that due to the dependability of the Type K Interlocking Relay their use for varied applications will be increased.

The simplified circuit shown in Figure 28 is the usual application of an interlocking relay for highway crossing protection on single track, or on double track where train operation is in "either direction." This

figure shows the operated circuit normally open at the interlocking relay and is for a normally de-energized type of crossing signal such as the flashing-light type.

Figure 29 is a typical circuit for a normally energized signal such as a Wig-Wag signal provided with a slot coil. The slot coil circuit is normally closed through front contacts of the interlocking relay; therefore the relay must be provided with front contacts that remain closed when the armature is in the locked position.

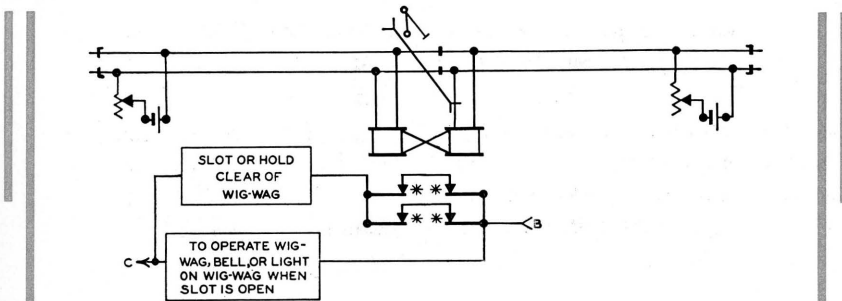


Figure 29. Application of a Type K Interlocking Relay with front contacts that are closed in the locked position.

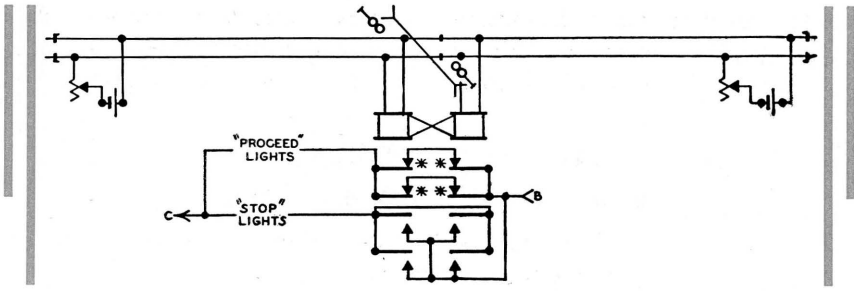


Figure 30. Application of a Type K Interlocking Relay for giving special crossing signal indications.

The circuit in Figure 30 utilizes the same type of front contacts as the circuit in Figure 29 for displaying a green or "go" indication to highway traffic when the approach track section is unoccupied, and also when the leaving track section is occupied. The red or "stop" light is controlled over back contacts as in Figure 28.

A portion of an automatic interlocking arrangement is shown in

Figure 31. In this case the back contact marked "3," which is on the approach side of the relay, is a special contact and is closed when the relay is de-energized regardless of whether the armature is in the locked position or not. This contact is used to approach light No. 1 signal for an East to West move and also to light the signal, when a train going from West to East has just cleared section

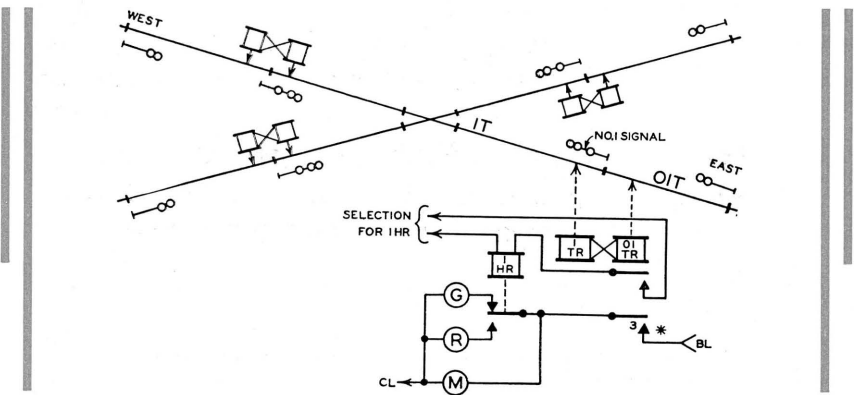


Figure 31. Application of Type K Interlocking Relays to automatic interlocking circuits.

1 T, to provide protection against a back up move. Under this condition No. 1 signal cannot display a green indication since its H control is cut through a regularly locked back contact on the same side of the relay.

Detail Information

Type K Interlocking Relay

Contacts: Four front and back dependent contacts on each side as shown in Figure 25.

Any of the following contact arrangements are available, as well as other special combinations, such as having one back contact closed with the armature in the locked position, if requested:

1. Front and back contacts open with the armature in the locked position.
2. Front contacts closed with the armature in the locked position.

All contacts are Universal.

Resistance: 2, 4, 11, 16, 50, 100, 136, 150, 200, 250, 300, 400, 450, 500, 670, 1,000, and 2,000 ohms.

Operation: Regular, slow-release, or slow-pickup as desired.

Operating Values: For a four ohm relay; values for other resistances on this ampere turn base:

Working Current, Max. - - - - - 0.075 amp.
Pickup Current, Max. - - - - - 0.075 amp.
Release Current, Min. - - - - - 0.037 amp.

Overall Dimensions: Height $8\frac{1}{8}$ " , Width $12\frac{5}{8}$ " , Depth $7\frac{1}{16}$ " .

When Ordering: See our Catalog E, Vol. 1, Part 23, Plate E 2301. Specify special contact arrangement if desired.

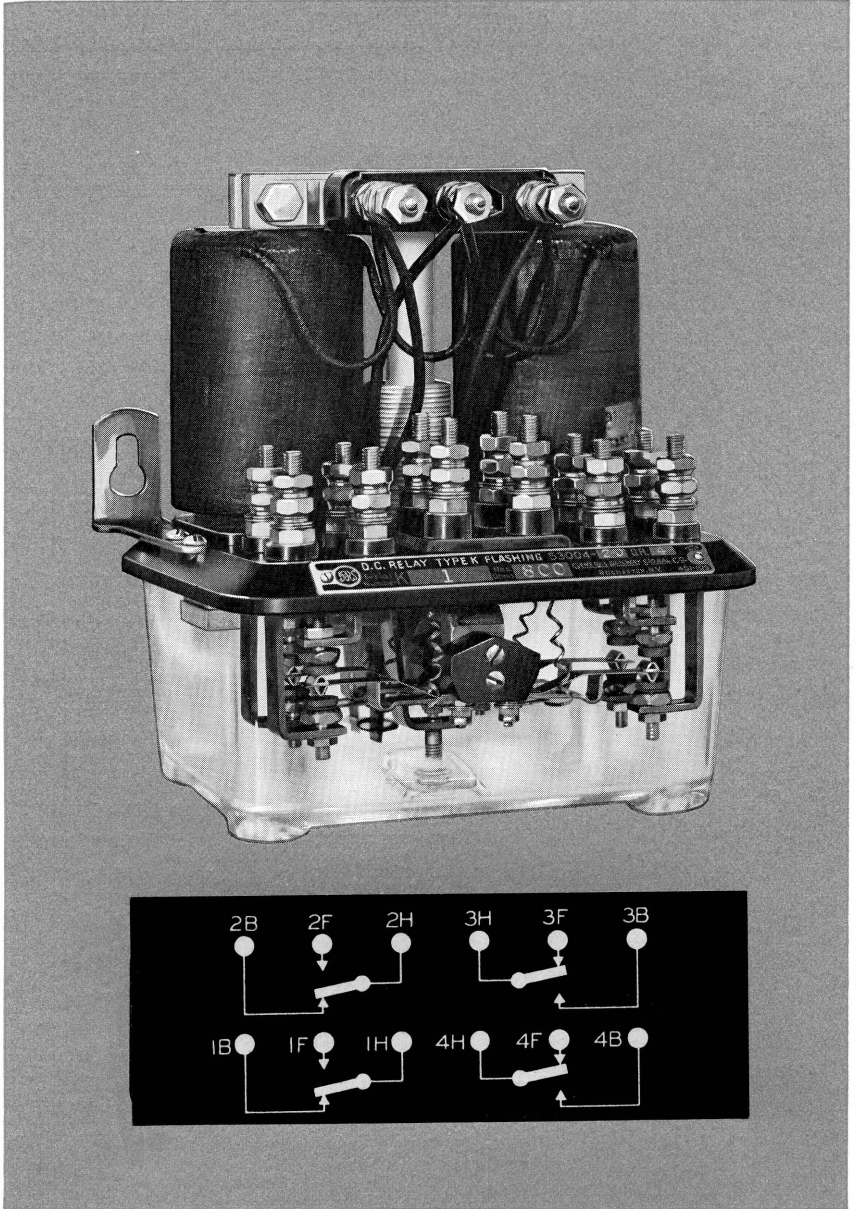


Figure 32. The Type K Flashing Relay and its Terminal Arrangement.

Type K Flashing Relay

THIS relay, Figure 32, is a new and simple relay for operating flashing-light type highway crossing signals. It is extremely neat in appearance and is no larger than the Type K Neutral Relay, Size Four. Its high magnetic efficiency and high standard of construction is characteristic of all Type K Relays.

Uniform Flashing

The duration of the flashes, as well as the time interval between flashes, remains uniform and equal regardless of variations in line voltage;

therefore the lights of the highway crossing signal always flash as positively and as regularly as the tick of a watch.

Operation

Figure 33 illustrates the operation of this relay and shows the arrangement of the various parts. Note that the armature is mounted so that it may rock from side to side.

When the relay is de-energized, Figure 33A, the armature assumes the central position with all back contacts closed. At the instant voltage is applied to the relay both coils are energized and the armature may

move either to the right or left. If to the right, Figure 33B, the right hand coil is shunted by the control contact, while the right hand front contacts and the left hand back contacts are closed. The armature then moves to the left, Figure 33C, at which time the left hand coil is shunted by the control contact, while the left hand front contacts and the right hand back contacts are closed. Thus

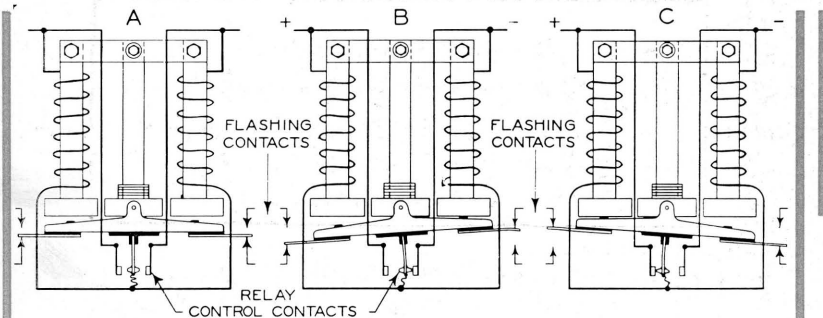


Figure 33. Operation of the Type K Flashing Relay.

as long as energy is supplied, the armature will rock from side to side.

Radio interference, as well as arcing and burning of the control

contacts, is eliminated because of the introduction of a condenser and the shunting action of the control contacts.

Application

Figure 34 illustrates a simplified circuit showing a typical application of the Type K Flashing Relay as used to operate flashing-light signals at a highway crossing.

This circuit is arranged so that the flashing relay shunts the signal lamps on one side of the crossing alternately and operates both signals simultaneously.

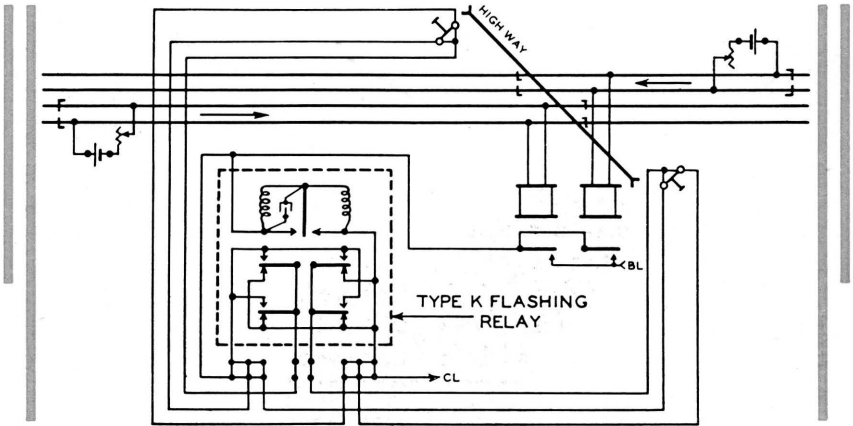


Figure 34. Application of the Type K Flashing Relay for operating highway crossing signals.

Detail Information Type K Flashing Relay

Contacts: Four front and back dependent contacts as shown in Figure 32.

All lamp contacts are Universal.

Voltage and Resistance:

For 6 to 8 Volt service—300 ohms per side

For 8 to 10 Volt service—600 ohms per side

For 10 to 12 Volt service—800 ohms per side

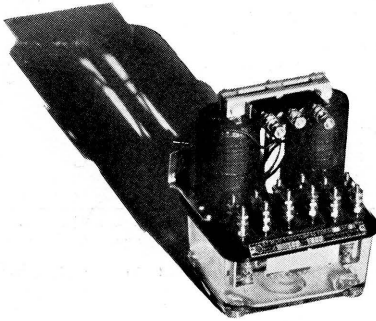
Operation and Operating Values.

Rate of flashing is between 30 and 40 per minute.

These relays do not have "pickup" and "dropaway" values and are adjusted for rate of flashing at the different voltages at the factory.

Overall Dimensions: Height $8\frac{5}{8}$ " , Width $7\frac{3}{8}$ " , Depth $6\frac{3}{8}$ " .

When Ordering: See our Catalog E, Vol. 1, Part 23, Plate E 2305. Specify rate of flashing.



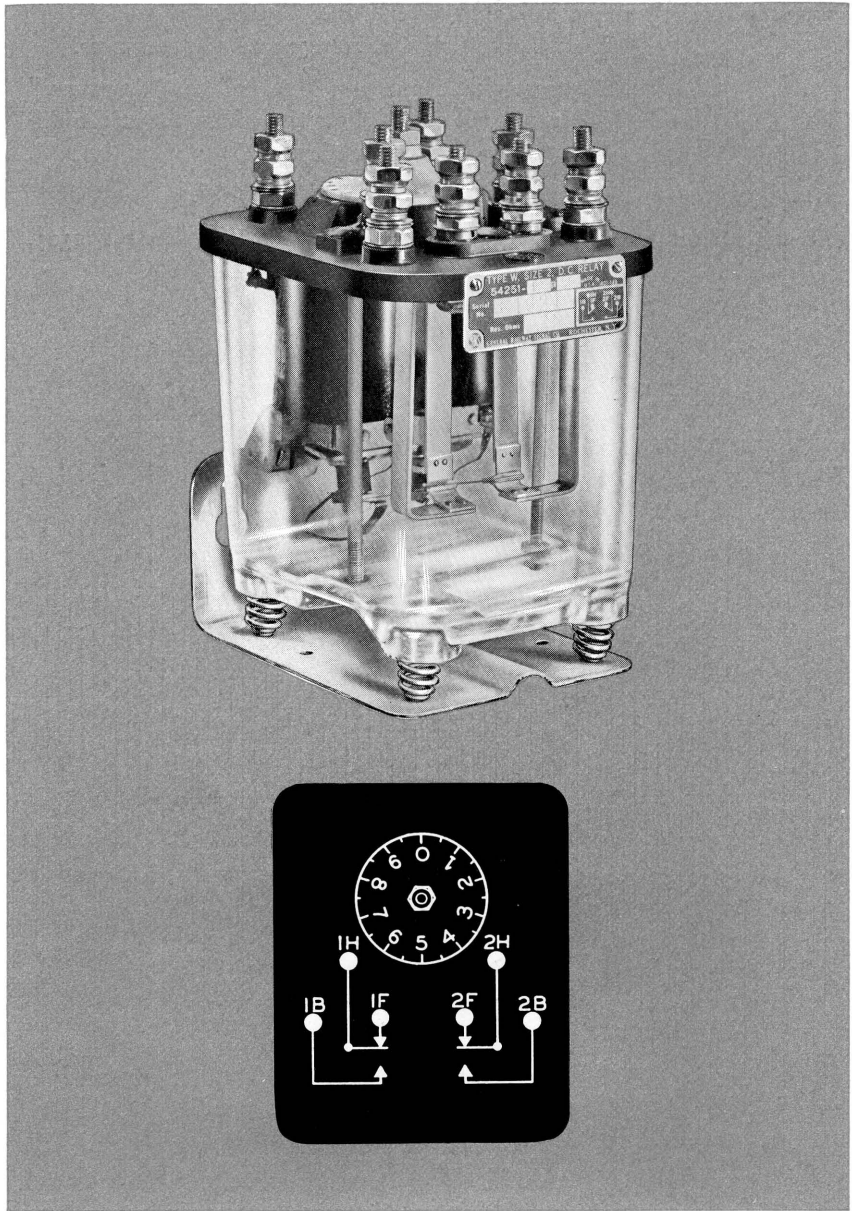


Figure 35. The Type W Relay, Class A, and its Terminal Arrangement.

Other G-R-S Relays for D. C. Signaling

TYPE K Relays are standard relays and cover all usual direct current signaling requirements. However, there are a number of small special-purpose relays that are not included in the Type K Line. A brief description of these relays is included in this Type K Relay Bulletin so that practically every relay that may enter into direct current signaling will be included under one cover.

These supplementary relays are as follows:

Type W Relay, Class A

Type W Relay, Class B

Type W Relay, Class E

Type T Thermal Relay, Class A

Type T Thermal Relay, Class B

Type W Relays are small special-purpose relays having many different applications. The Class A Relay is for direct current operation and the Class B Relay is for alternating current operation, while the Class E Relay is for either direct or alternating current operation.

The Type T Thermal Relay, Class A, is for introducing a short time element into a circuit. This relay is non-adjustable.

The Type T Thermal Relay, Class B, is for introducing a longer time element, usually 2 minutes, into a circuit. This relay is adjustable.

Type W Relay, Class A

THIS small, low current, series relay, Figure 35, has been designed for a wide application and to operate on direct current. For example, it can be used as an "approach-lighting" relay, a series "light-out" or "reserve-indication" relay, or a "power-off" or "power-transfer" relay.

Very little current is required for its operation, while slight changes in the combination of parts take care of the many new uses constantly arising for this type of relay and make it universal in application.

All relay parts are supported by a moulded bakelite cover, the large cores being imbedded in the bakelite during the moulding operation.

The yoke is a separate unit and is a circular steel forging with raised graduations on its surface to aid in its calibration. This yoke is arranged so that the air-gap between it and the cores may be varied for securing different operating values. Further adjustment can be made by shunting one of the coils for doubling the operating values.

This relay should be adjusted in the field in order to secure correct operation.

Application

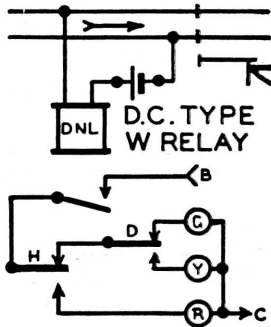


Figure 36. Application of a D. C. Type W Relay for series track approach lighting.

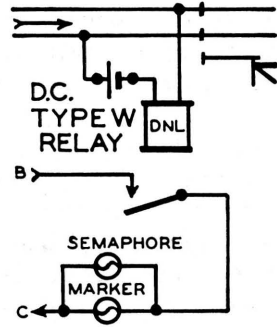


Figure 37. For series track approach lighting a semaphore lamp.

The efficient and dependable operation of the D. C. Type W Relay makes it very desirable for many uses. The accompanying circuits show typical applications.

Figure 36 illustrates its use as a series track approach-lighting relay for a color-light signal on double track. Here it can take the place of the track resistance unit and

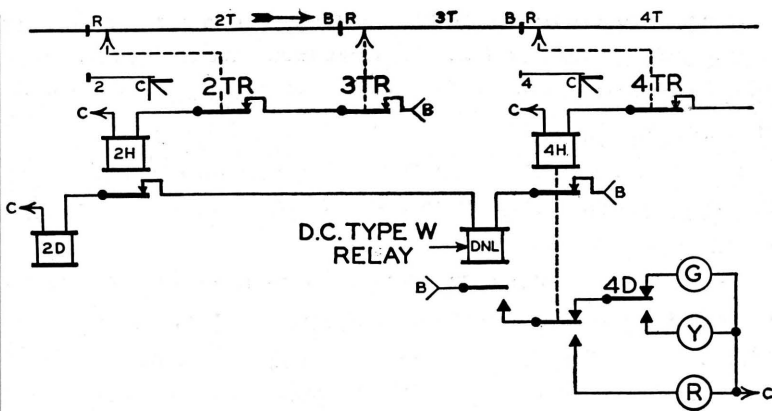


Figure 38. For series line approach lighting on double track.

is arranged to pick up when a train enters the track section. A similar application for approach lighting the lamps of a semaphore signal is shown in Figure 37. This method is often used to replace oil lamps on existing semaphore signals where primary batteries furnish the electrical energy.

Figure 38 shows a D. C. Type W Relay in series with the D Relay of the signal in advance for securing approach lighting in double track territory. Where approach lighting is desired in A.P.B. territory, the

D. C. Type W Relay is connected in series with the HD relay of the signal immediately in advance.

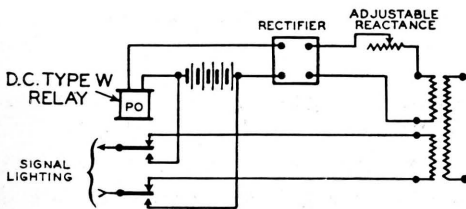


Figure 39. In series with a battery charging circuit.

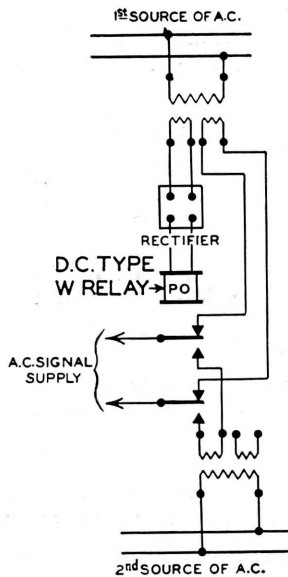


Figure 40. For duplicate A. C. sources.

Figure 39 shows a D. C. Type W Relay in series with the battery charging circuit for securing power-off protection. With this circuit the reserve battery can be cut in to supply energy to the lamps at a much higher percentage of normal A. C.

line voltage than when an A. C. relay is used for this purpose.

Figure 40 shows a rectifier fed D. C. Type W Relay used for transferring the load to a duplicate A. C. source when the first A. C. source fails or its voltage drops too low.

Detail Information ***Type W Relay, Class A***

Contacts: Two front and back dependent contacts as shown in Figure 35. One front and back dependent contact when desired.

All contacts are silver to silver.

Resistance: Any usual resistance can be furnished.

Operation and Operating Values: Dependent upon particular use of relay, and adjustment.

Overall Dimensions: Height $6\frac{1}{16}$ " , Width $4\frac{3}{8}$ " , Depth $5\frac{1}{4}$ " .

When Ordering: See our Catalog E, Vol. 1, Part 24, Plate E 2401.

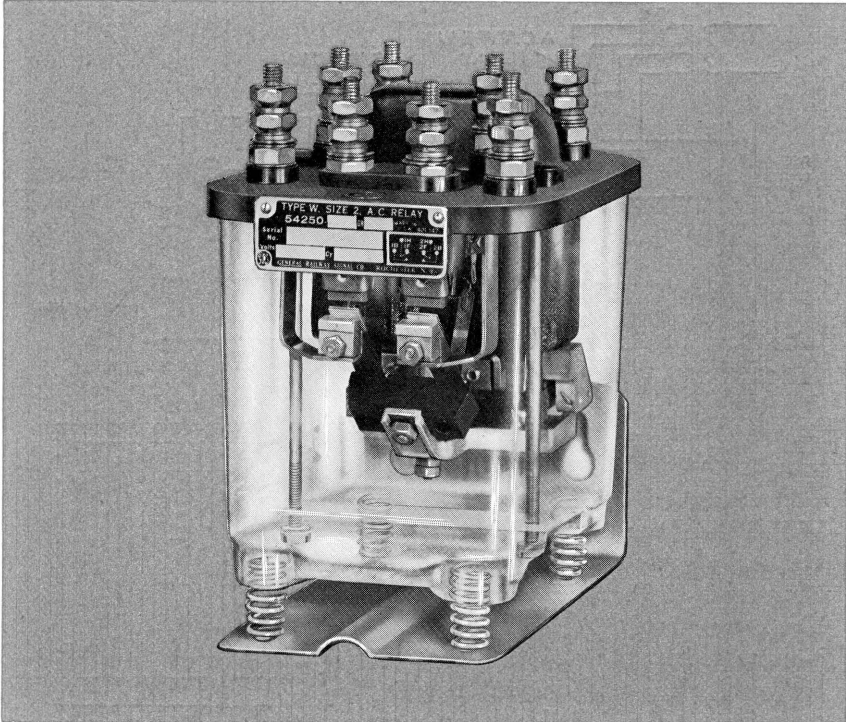


Figure 4I. The Type W Relay, Class B.

Type W Relay, Class B

THE A. C. Type W Relay, Figure 4I, is very similar in appearance, construction, and application to the D. C. Type W Relay. It, too, has been designed to be universal in application.

This relay is quiet in operation. It has a wide trunnion structure, a heavy armature structure, adequate back contact pressure, and therefore overcomes many difficulties experienced with previous relays of this type.

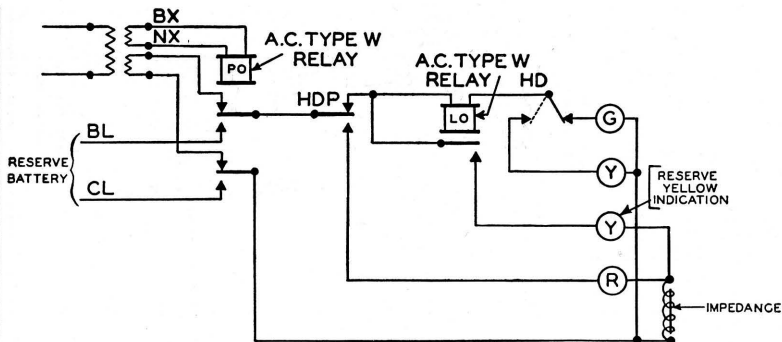


Figure 42. Application of an A. C. Type W Relay to light an auxiliary unit for light-out protection.

Application

Figure 42 shows an A. C. Type W Relay used for power-off protection and another A. C. Type W Relay used to light an auxiliary unit. This latter arrangement permits lamp bulbs to be left in service their full life without stopping trains when the green or yellow lamp burns out.

The most usual application of the A. C. Type W Relay is shown in Figure 43 where it is used as a straight power-off or power-transfer relay.

Wherever alternating current track or line circuits are used this relay can be used as a series approach-lighting relay.

Figure 44 shows a rectifier fed track circuit with an A. C. Type W Relay used to cut in a reserve primary battery.

Figure 45 shows this relay connected in series with the filament of the lamp giving the green indication

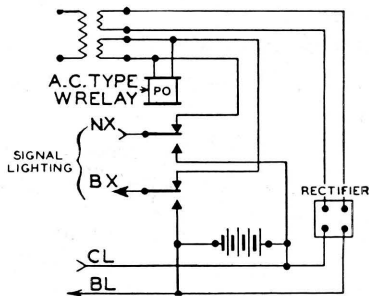


Figure 43. For power-transfer.

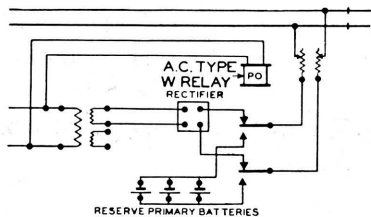


Figure 44. For a rectifier fed track circuit.

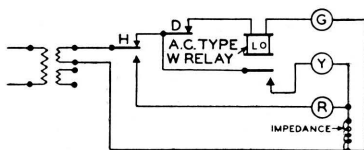


Figure 45. For light-out protection.

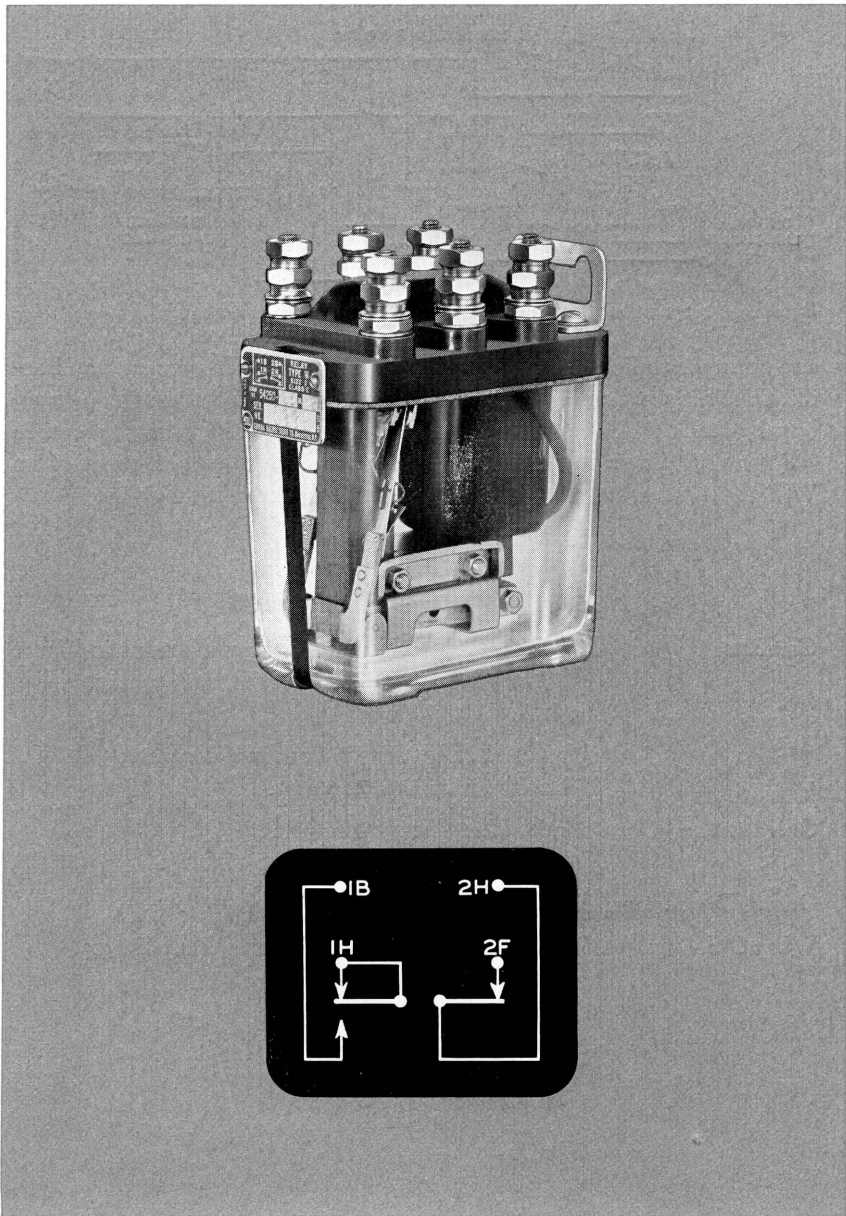


Figure 47. The Type W Relay, Class E, and its Terminal Arrangement.

Type W Relay, Class E

THIS Type W Relay, Figure 47, will operate on either alternating or direct current.

It is similar in general design to the A. C. and D. C. Type W Relays, although its small size permits it to be mounted in signal housings where it can easily be connected in series with the signal lamp.

Application

The usual application of the Type W Relay, Class E, is in series with any light-signal lamp where 5 volt-amperes at 60 cycles, or 2.5 volt-amperes at 25 cycles, additional energy may be taken from the supply for its operation.

Figure 48 shows this relay in series with the regular lamp; therefore when this lamp burns out the

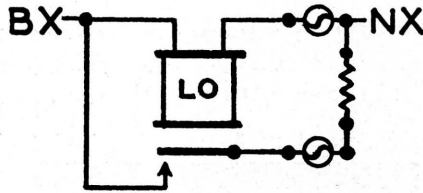


Figure 48. Application of the Type W Relay, Class E, for light-out protection.

reserve lamp will be lighted, since its control is cut over a back contact of the relay.

Detail Information

Type W Relay, Class E

Contacts:

One independent front contact and one independent back contact as shown in Figure 48. Two independent front contacts or two independent back contacts as desired.

All contacts are silver to silver.

Overall Dimensions: Height $5\frac{3}{16}$ " , Width $2\frac{1}{2}$ " , Depth $3\frac{1}{8}$ " .

When Ordering:

Give the definite application so that relay having the correct contact combination for the particular purpose desired will be furnished, also give the frequency of current and the voltage and wattage of lamps.

Type T Thermal Relay, Class A

THIS non-adjustable Thermal Relay, Figure 49, has been developed especially for use in circuits where a short time element is required. Its most common application is to bridge the time interval between the picking up of a relay on the leaving track section and the shunting of the relay on the entering track section. This application prevents the loss of directional control or the momentary loss of approach locking which might otherwise occur when a light engine or gas-electric car passes from one track section onto the next at high speed.

Application

Figure 50 is an A.P.B. color-light signal application, the circuit being

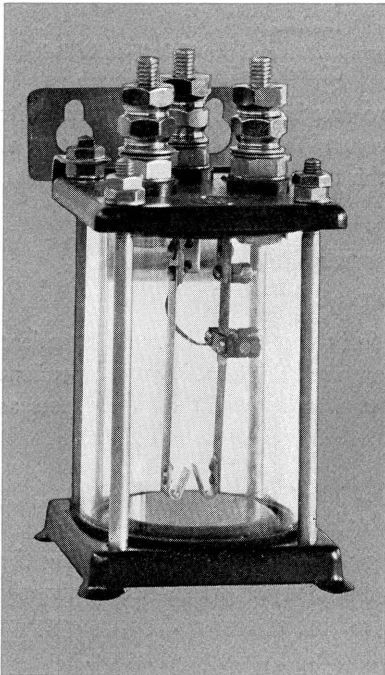


Figure 49. The Type T Thermal Relay, Class A.

simplified to illustrate how the Type T Thermal Relay operates in these circuits.

The PC relay is a slow-release repeater of the HD relay and, in addition, has a delayed pickup due to the introduction of a Type T Thermal Relay in its pickup-circuit. The slow-release feature of this PC relay prevents a red signal flash when the HD relay is changing polarity and also provides a means of picking up the stick relay, while its slow-pickup feature prevents its picking up should the HD relay become momentarily energized when a light engine passes over the insulated joints at high speed.

When the train leaves the block, the PC relay will pick up after current flowing through the heating coil has closed contacts "2" and "3." The heating coil is then shunted and will cool off; thereby placing the circuits in readiness for the next train movement.

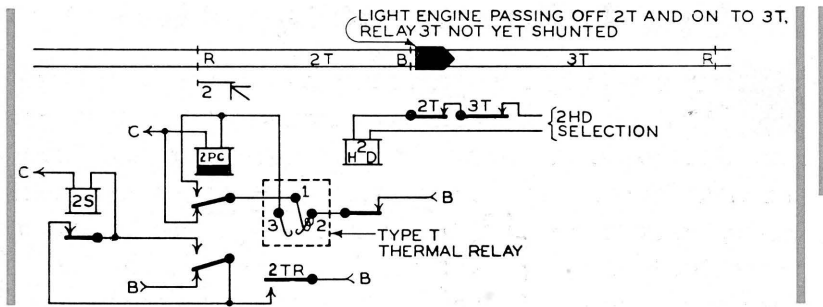


Figure 50. Application of the Type T Thermal Relay, Class A, to A.P.B. Circuits.

Detail Information

Type T Thermal Relay, Class A

Contacts: One independent normally open silver to silver contact. Contact opening 0.050".

Operation and Operating Values:

The usual operating time of the relay is 5 seconds at 8 volts. When specified, relays will be furnished to operate in any time from 5 to 20 seconds. At rated 8 volts the resistance of the Type T Thermal Relay is 11.3 ohms and the current 0.70 amp. Approximately 15 seconds are required for the heater winding to cool off sufficiently to permit the contact fingers to open far enough to require 2 seconds for them to close for a successive operation.

The usual variation in line voltages encountered in the field does not materially affect its time of operation from rated time. In addition, variations in external temperatures have little effect on the operating time of this relay. When set for 5 seconds normal closing time it will not vary more than a fraction of a second with a range of temperature from 20° F. below to 160° F. above. This close regulation is secured by arranging the two thermostatic contact fingers so that temperature changes have the same effect on both.

Overall Dimensions: Height 5 $\frac{3}{16}$ ", Width 2 $\frac{11}{16}$ ", Depth 2 $\frac{11}{16}$ ".

When Ordering* See our Catalog E, Vol. 1, Part 25, Plate E 2501.

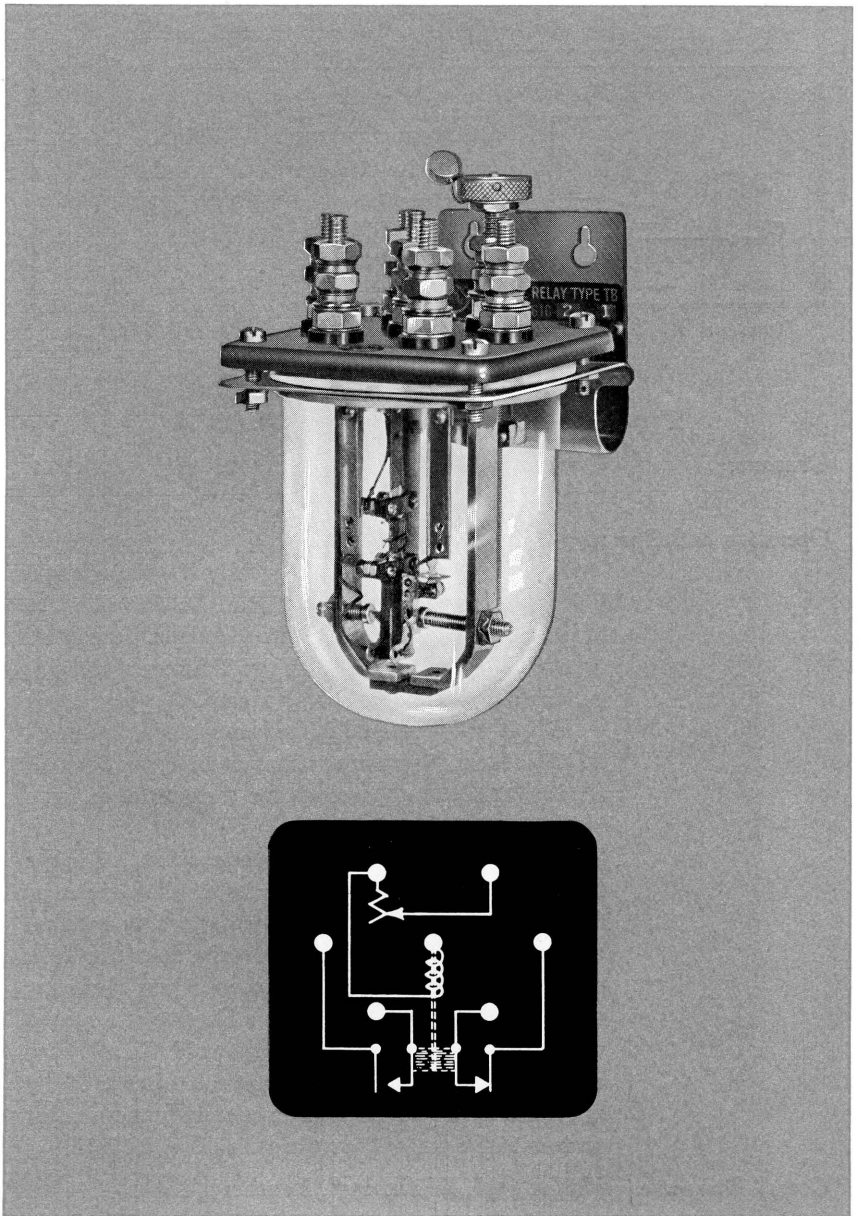


Figure 51. The Type T Thermal Relay, Class B, and its Terminal Arrangement.

Type T Thermal Relay, Class B

THIS adjustable thermal relay, Figure 51, operates on the same principle as the Type T Thermal Relay previously described, but is for use where a longer time element is required, and also where a pair of normally closed contacts are required in order to check the relay's operation back to normal or for other purposes. The Adjustment feature is incorporated in this relay to make accurate compensation in the field for differences in voltage at different locations and to assure that the exact time interval required is obtained.

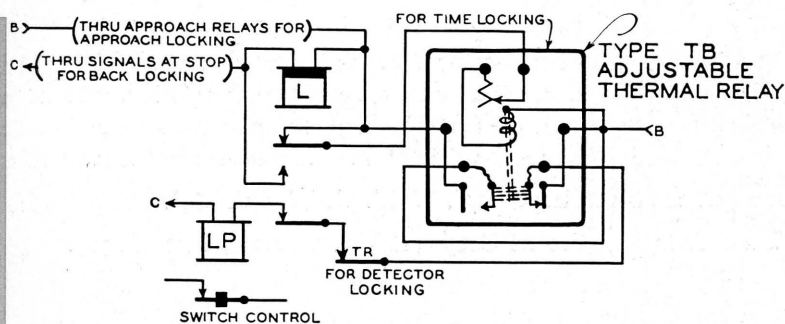


Figure 52. Application of the Type T Thermal Relay, Class B, to automatically release approach locking.

Application

A usual application of this relay is for the automatic release of approach locking. Figure 52 shows such an application and illustrates the operation of this relay. As applied in this case, the thermal relay is used to pick up the L (lock) relay after a certain definite time interval (usually 2 minutes) has elapsed after a signal which had been cleared for an ap-

proaching train is restored to stop. The path of current to operate the thermal relay, with all signals at stop and a train on the approach section, is positive energy through the heating element and the adjustable resistance, to negative battery through a back contact of the L relay and the signals at stop. Then when the left contacts close in the predetermined

time, the L relay picks up and is held up through its own front contact, the adjustable resistance, and the heating element. The coil of the L relay being cut into the heating element circuit allows the heating element to cool; thereby opening the

left contacts and closing the right contacts.

By controlling the LP relay through the right or check contacts, operation of the switch is prevented until the thermal relay has functioned and returned to normal.

Detail Information
Type T Thermal Relay, Class B

Contacts: One normally closed silver to silver independent contact, and one normally open silver to silver independent contact, as in Figure 51.

Operation and Operating Values:

Dependent upon the service. The time of operation is the total time from the instant that current is applied to the instant that the normal closed contact remakes after the movable finger has passed across and made contact on the left side and returned to the right side.

Overall Dimensions: Height $5\frac{5}{16}$ " , Width $3\frac{1}{2}$ " , Depth $4\frac{7}{8}$ " .

When Ordering: See our Catalog E, Vol. 1, Part 25, Plate E 2503.

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