GEH-1151B

INSTRUCTIONS

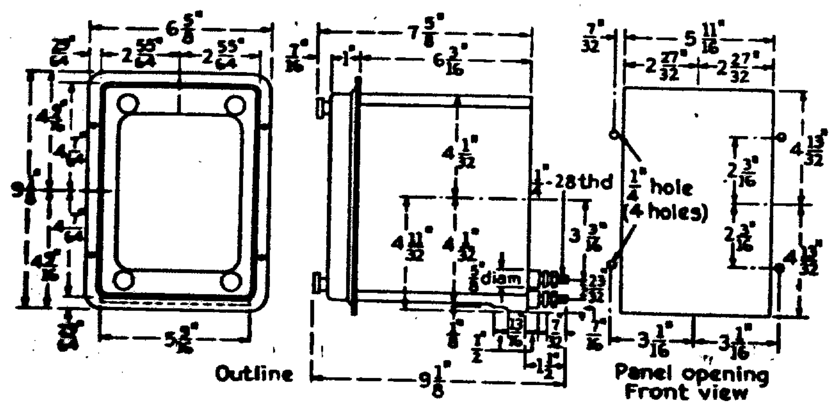
PERCENTAGE DIFFERENTIAL RELAYS

TYPES

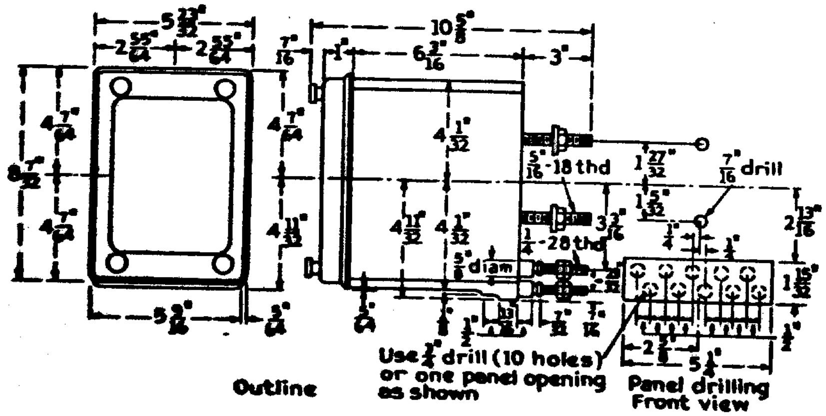
IJD11C
IJD12A
IJD12B
IJD12C
IJD14A
IJD14B

IN DRAWOUT CASE

GENERAL ELECTRIC
SCHENECTADY, N.Y.



For Flush Mounting



For Surface Mounting

Fig. 1. Outline and Panel Drilling Dimensions for Drawout Case, One Unit, Single End

PERCENTAGE DIFFERENTIAL RELAYS

TYPE IJD

The Type IJD relays are percentage differential relays for the protection of alternating-current generators and transformers against internal faults. There is also a Type IJD relay for the protection of alternating-current transmission lines using pilot wires.

Type IJD relays operate when the ratio between two currents becomes a definite percentage greater than a predetermined ratio. The coils are usually wound for connection to the secondaries of current transformers. The contacts are suitable for closing circuit-breaker trip circuits and other similar control circuits.

To insure successful operation of these relays in the differential protection of a-c generators, it is important that the characteristics of their operating current transformers conform as closely as possible, and do not deviate by as much as 10 per cent at the highest fault currents obtainable; otherwise the relay may function on faults occurring at points external to the differentially protected area. For this reason current transformers of the highest grade should be selected for this service. Since these characteristics are adversely affected by large secondary burdens, it is further recommended that no burden other than that of the relay be carried by the current transformers. If it should be necessary to place additional burden upon them, the total borne by each transformer should not exceed 30 volt-amperes, based upon 5 amperes secondary current. This additional burden should also be divided as equally as possible between the two current transformers in each phase, and in no case should a burden unbalance exceeding 10 volt-amperes be permitted. In balancing the secondary burdens any discrepancy in the respective lengths of the secondary leads should receive due consideration.

DRAWOUT CASE

There are three principal sizes of drawout cases, each of which has studs for external connections at both ends or only at the bottom. These are respectively referred to as "double-end" and "single-end" cases. In either construction, the electrical connections between the relay units and the case are made through stationary molded inner and outer blocks; between the blocks nests a removable connecting plug which completes the circuits. The outer block, attached to the case, has the studs for external connections, and the inner block has terminals for the internal connections.

The relay mechanism is mounted in the steel framework, called the cradle, and is a complete unit with all leads being terminated at the inner block. This cradle is held firmly in case by a latch at both top and bottom and by a guide pin at the back of the case. The connecting plug, besides making the electrical connections between the respective blocks of the cradle and case, also locks the latch in place. The cover, which is drawn to the cradle by thumbscrews, holds the connecting plug in place.

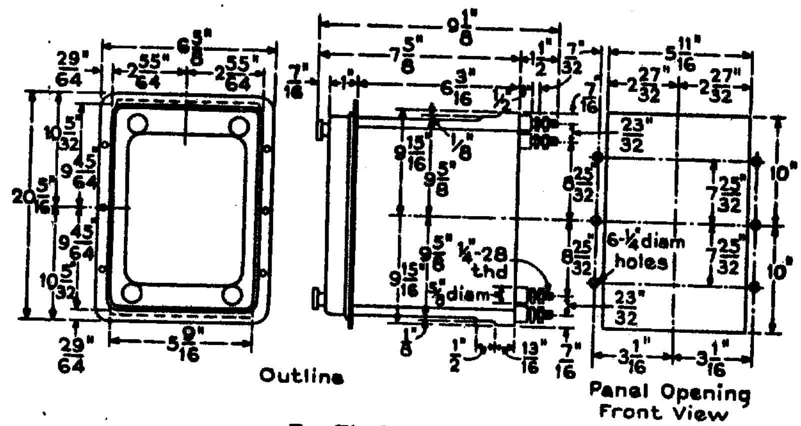
To draw out the cradle, the cover must first be removed. Then the plug can be drawn out. In so doing, the trip circuit is first opened, then the current-transformer circuits are short-circuited and then disconnected from the relay elements, and finally the voltage circuits are opened. After the plug has been removed, the latch can be released and the cradle easily drawn out. To replace the cradle, the reverse order is followed.

The relay may be tested while mounted on the panel, either from its own or another source of power, by replacing the connecting plug with a separate testing plug. Or the cradle can be drawn out and replaced by another, which has been laboratory tested.

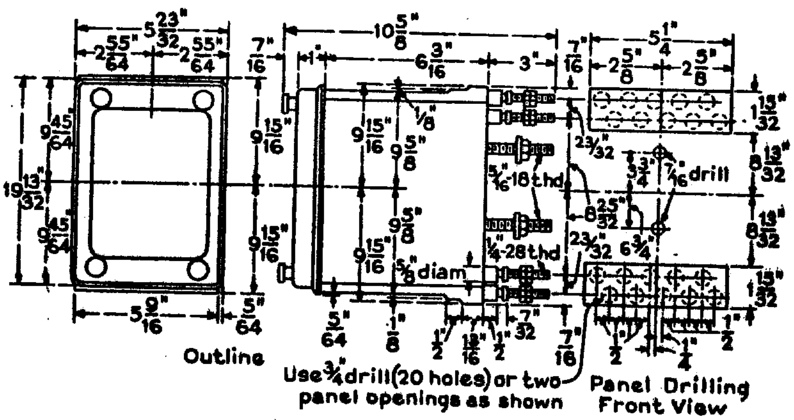
INSTALLATION

The relay should be mounted on a vertical surface by its supporting studs or screws. The disk shafts should be vertical.

The location should be clean, dry, and free from excessive vibration.



For Flush Mounting



For Surface Mounting

Fig. 2. Outline and Panel Drilling Dimensions for Drawout Case, Three Unit, Double End

For panel drilling and outline dimensions see Fig. 1 and 2.

The internal connections to the terminal studs are shown in Fig. 3 to 8. For typical external connections see the section on "Application and Characteristics."

A permanent ground connection to one of the steel supporting studs or screws is recommended. A conductor equivalent to No. 12 B&S. copper wire or larger should be used.

Before the relay is finally placed in service suitable current tap settings should be made, and the correctness of the current transformer connections checked as described in the section on "Application and Characteristics." Make sure that there is no friction in the moving parts, by closing the contacts by hand; when released the disk should reset with a steady motion.

OPERATING PRINCIPLE

Each relay unit is a complete induction disk relay having two shaded-pole, U-magnet-type driving elements acting on opposite sides of the single disk. One of these, the operating element, drives the disk in the contact-closing direction; the other, the restraining element, drives the disk in the contact-opening direction. A contact-making mechanism is geared to the disk shaft.

The coils of the relay are connected to current transformers in both leads to the generator or power transformer winding being protected. The two currents thus supplied to the relay coils bear a certain ratio to each other under normal conditions, and the relay operates when this ratio increases by a definite percentage as the result of a fault in the apparatus.

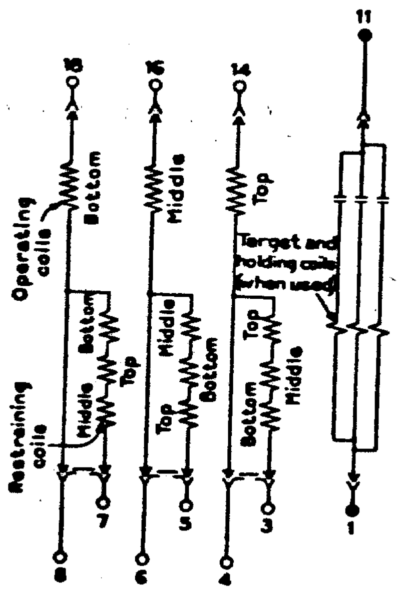


Fig. 3. Internal Connections, Type IJD11C Relay (Back View)

The manner in which this percentage characteristic is obtained will be evident from the connections shown in Fig. 9, which illustrates a case where the two currents are normally equal, as in a generator circuit. In this case each current flows through an equal number of restraining turns, wound in the same direction and the total restraining force is therefore proportional to total restraining turns $\times \frac{1}{2}(I_1+I_2)$. Similarly the operating force is total operating turns $\times (I_2-I_1)$. The contacts are therefore held in the open position since the operating force is zero.

When a fault occurs in the generator winding, the two currents are no longer equal and the difference flowing in the operating coil will, if large enough, cause the operating element to overcome the restraining element driving force and operate the contacts. How large the difference will need to be depends on the number of turns in the coils. For example, if the operating coil has approximately ten times as many turns as both restraining coils together, one current will have to exceed the other by slightly over 10 per cent between the relay operates.

For generator protection it is usually possible to use identical current transformers in both leads to the winding and obtain practically equal secondary currents. The form of relay described above is therefore suitable for generator protection.

However, in the protection of two-winding power transformers, it is not always possible to obtain standard current transformers which will supply equal secondary currents. For such applications, the relay is provided with coil taps arranged to provide for the unequal currents and thereby prevent operation on through faults. This tap arrangement, see Fig. 11, shows a design suitable for a relay with a 25 per cent characteristic. The turns on the restraining element marked "minus" oppose the remainder of the turns marked "plus."

Consider first the case where $I_1=I_2=5$ amperes. Both tap plates, A and B, should then be set at 5 amperes. The total restraint is proportional to $11\times\frac{1}{2}(5+5)$ or 55 ampere-turns, while the total operating force is zero. Should either current increase 25 per cent, to 6.25 amperes, the restraining force becomes proportional to $11\times\frac{1}{2}(6.25+5)$ or 61.8 ampere-turns, while the operating force becomes proportional to $50\ (6.25-5)$ or 62.5 ampere-turns. The operating element thus overcomes the restraint and the relay contacts close.

Suppose, however, that at normal full load $I_1=4.2$ amperes and $I_2=8.7$ amperes. Tap A should then be set at 8.7 amperes and tap B at 4.2 amperes. I_2 will produce actual restraining ampere-turns of $8.7\ (5.5-2)$ or 30.4, while the restraining effect of I_1 will be proportional $4.2\times(5.5+1)$ or 27.3 ampere-turns. The total restraint is therefore proportional to $30.4+27.3$ or 57.7 ampere-turns. At the same time the ampere-turns in the operating element are the difference between $29\ (I_2-I_1)$ and $30.5\times I_1$ which is nearly zero, and therefore the contacts remain open.

The coil turns for the other taps provided on the relay are chosen to obtain the same results.

TYPES IJD12A AND IJD12B

The Type IJD12A is a single-unit and Type IJD12B is a three-unit relay for the protection of generators against internal faults. Typical connections for this protection are shown in Fig. 10.

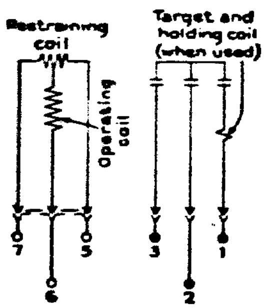


Fig. 4. Internal Connections, Type IJD12A Relay (Back View)

Before placing the relay in service, the correctness of the current transformer connections and equality of the two currents supplied to each unit should be checked at the highest load obtainable on the generator. These checks can be made by inserting an ammeter in the circuit between each operating coil stud and the neutral return wire to the current transformers, and reading on it the difference between the two currents; the ammeter reading should be zero.

Characteristics

With no load on the generator, and with zero current on the line side of the generator, the minimum secondary current on the other side to operate the relay will be 0.1 ampere. At various load currents the minimum operating current will be as shown in Fig. 18. It will be noted that above 4 amperes or so a constant difference between the two currents of 10 per cent is required to operate the relay. As long as there is no fault in the generator windings this 10 per cent difference will not occur, even for large external faults, if the current transformers have been properly chosen. On the other hand, a very small fault in the generator will operate the relay.

The operating time curve is shown in Fig. 19.

Contact Rating

The current-closing rating of the contacts is 30 amperes for voltages not exceeding 250 volts. The current-carrying ratings are limited by the two different ratings of target and holding coils as indicated in the following table:

Function	AMPERES, A-C OR D-C	
	1 amp (0.25 ohm) Tar. and Hold. Coil	0.2 amp (7 ohm) Tar. and Hold. Coil
Tripping Duty	30	5
Carry Continuously	4	0.8

The 0.2-ampere coil is for use with trip coils that operate on currents ranging from 0.2 up to 1.0 ampere at the minimum control voltage. If this coil is used with trip coils that take 1.0 ampere or more, there is a possibility that the 7-ohms resistance will reduce the tripping current to so low a value that the breaker will not be tripped. This coil can safely carry tripping currents as high as 5 amperes.

The 1.0-ampere coil should be used with trip coils that take 1.0 ampere or more at the minimum control voltage, provided the tripping current does not exceed 30 amperes at the maximum control voltage. If the tripping current exceeds 30 amperes, an auxiliary relay must be used to control the trip coil circuit, the connections being such that the tripping current does not pass through the contacts or the target and holding coil of the protective relay.

When it is desirable to adopt one type of relay as standard to be used anywhere on a system, relays with the 1.0-ampere coil should be chosen. These relays should also be used when it is impossible to obtain trip coil data,

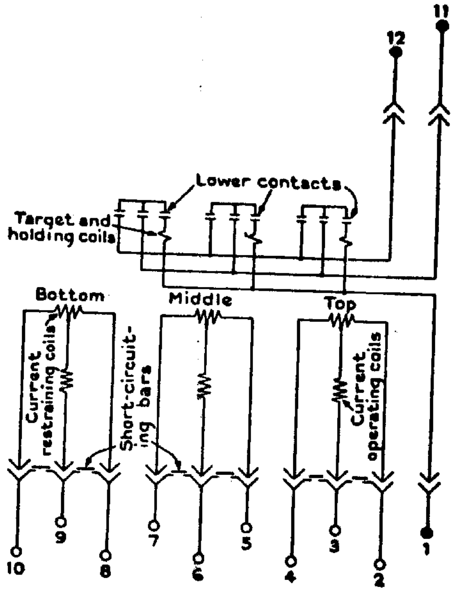


Fig. 5. Internal Connections, Type IJD12B Relay (Back View)

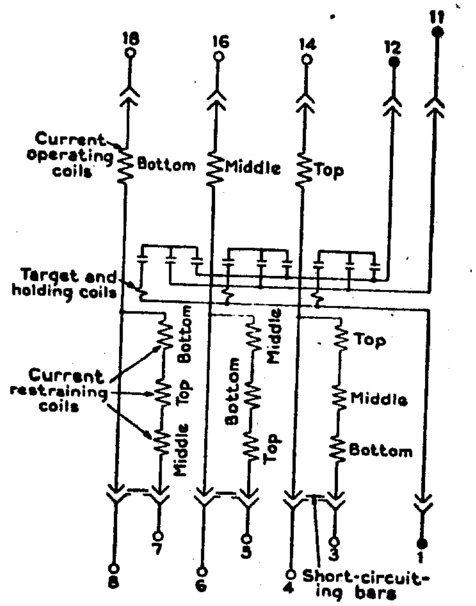


Fig. 6. Internal Connections, Type IJD12C Relay (Back View)

but attention is called to the fact that the target may not operate if used with trip coils taking less than 1.0 ampere.

Volt-ampere Burdens

The burdens imposed on the current transformers are as follows:

Relay Rating	Coil	Freq	Amp	V-a	Watts
5 amp 60 cyc..	Restr	60	5	20	6
0.1 amp min....	Oper	60	0.1	0.66	0.356
	Oper	60	5*	1650	890
	Restr	25	5	9.5	6
5 amp 25 cyc..	Oper	25	0.1	0.342	0.222
0.1 amp min....	Oper	25	5*	855	555

* Burdens calculated from minimum pickup measurement.

TYPES IJD11C AND IJD12C

These are three-unit relays used with pilot wires for the protection of transmission lines and distribution lines. Typical connections for this protection are shown in Fig. 12. The Type IJD11C relay has single-circuit closing contacts while the Type IJD12C relay has two circuit-closing contacts.

The principle of this protective scheme is shown by the single-line diagram, Fig. 13. It will be seen that there are two parallel circuits across each current transformer secondary.

Under normal conditions the current in the resistor circuit at both ends of the line will be the same, and the voltage drop across each will be equal. Therefore, no current will flow in the operating coils and pilot wires, regardless of the magnitude of the line current. However, if any fault occurs in the line, the current in the resistor circuit at the two ends will no longer be the same, and current will flow in the pilot wires and operating coils of both relays.

The relays provide protection for both phase-to-phase and phase-to-ground faults. The minimum fault current required at various load currents to operate the relay is shown in Fig. 20. The 5-ohm resistor is recommended for most applications.

The current transformer secondaries should be grounded through cutout at one station and solidly grounded at the other station. The cutout prevents the circulation of current in the pilot wires because of a difference in the potential of the ground at the two stations, and provides the necessary ground for safety in case a high potential appears on any part of the pilot-wire system. (A cutout is furnished with each two relays.)

Always remove top connecting plug first and replace last to prevent relay on opposite end of pilot wire from tripping falsely.

Pilot-wire Cable

A three-conductor, lead-covered cable insulated for 600 volts, d-c, should be used. A suitable conductor size is No. 8 B&S copper wire.

Relay Characteristics

To obtain the operating curves shown in Fig. 20 the relay is adjusted to have a test characteristic as shown in Fig. 22, using only the center section of the restraining element coils and test connections as shown.

The relay is practically instantaneous in its operation.

Contact Rating

The IJD12A contact rating information previously given applies also to the contacts of IJD11C and IJD12C relays.

Volt-ampere Burdens

The normal burden on each current transformer is 126 volt-amperes, 125 watts at 5 amperes, 60 cycles, and is imposed by the resistor and restraining coil circuit. The normal burden of the operating coil circuit is zero since there is no current in this circuit except during a fault.

TYPES IJD14A AND IJD14B

These are percentage differential relays for the protection of two-winding power transformers. The Type IJD14A is a single-unit relay with two-circuit contacts; the Type IJD-14B is a three-unit relay with two-circuit contacts.

Typical connections for the protection of a Y-delta power transformer bank are shown in Fig. 14.

These relays are provided with taps as described under Operating Principle so that unequal currents may be supplied to the relay. However, it is recommended that the current transformer ratios be chosen to make the secondary currents in both transformers on each phase as nearly equal as possible. In the case of a Y-delta bank, one of the relay currents will be about 1.73 times the other; in the case of a delta-delta bank the two relay currents will be about equal.

It is not necessary to set the taps for actual full-load current. It is necessary only to have the ratio between the two tap settings nearly the same as the ratio between the two full-load currents. The actual full-load current on the taps should not exceed 8.7 amperes on relays rated 3.2 to 8.7 amperes.

It is recommended, however, that the tap settings be for not less than actual full-load current so that the minimum primary current in either current transformer alone which is required to operate the relay will not be less than 40 per cent of the corresponding full-load current. This will avoid difficulty caused by magnetizing inrush current. The relay is adjusted to close contacts on a minimum current in one secondary circuit to the relay (zero in the other) of 0.4 times tap value.

The above adjustment usually prevents incorrect operation due to the magnetizing inrush current that occurs when a transformer bank is connected to the line or bus. Should unusual conditions require it, the minimum operating current may be increased from 0.4 times tap value to a maximum of 1.25 times tap value by increasing the tension of the control spring on the disk shaft. (See section on minimum operating current under "Adjustments and Care.")

Before the relay is finally placed in service the correctness of the current transformer connections and of the tap settings chosen should be checked at the highest load obtainable on the transformer. Each unit should be checked separately by inserting an ammeter in each restraining coil lead and reading the two currents supplied to the relay. The ratio of these two currents should be the same as the ratio of the tap settings. There should be a definite torque on the relay disk in the contact-opening direction. Note also that the upper restraining coil

on each unit corresponds to the left-hand tap plate (front view), and make sure that the larger of the two currents goes to the tap plate having the larger setting (right-hand tap plate, front view.)

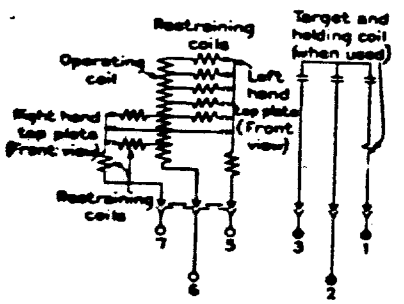


Fig. 7. Internal Connections, Type IJD14A Relay (Back View)

As an illustration of the application to transformer differential protection, suppose that the current transformer ratios are such as to give 3.2 amperes from one winding and 5 amperes from the other. Then one of the 3.2-ampere leads would be connected through terminal to the left-hand tap plate (see internal connection) and one of the 5-ampere to the terminal to right-hand tap plate of the pair of restraining coil terminals per relay unit per phase. The tap plugs would be placed in the 3.2 position on the left-hand tap plate and the 5 position on right-hand tap plate, front view. The relay will operate on values of current lying above the 3.2–5.0 tap characteristic shown in Fig. 21a and 21b.

NOTE: The tap block at the top of the frame in these relays is divided into two parts with two plates (one for each current circuit) with six tap holes in one plate and three in the other. There should always be a tap plug in both plates. When changing the tap setting of the relay while in the drawout case, remove the connection plug to short the current transformer secondary circuit. Next, screw the tap plug into tap marked for the desired current and then replace the connecting plug.

Characteristics

The left-hand tap plate has taps for 3.2 3.5, 3.8, 4.2, 4.6, and 5 amperes. The right-hand tap plate has taps for 4.6, 5, and 8.7 amperes.

At no load, or zero current in one circuit, the minimum operating current is 0.4 times rated tap value. For higher load (or external fault) currents, the relay operates when the ratio of the two relay currents exceeds the ratio of the tap settings by 25 to 35 per cent. The relay is adjusted to have as nearly as possible a 25 per cent ratio-increase characteristic, but on extreme tap ratios the characteristics may be as high as 35 per cent. Curves Fig. 21a and 21b show 25 per cent characteristics for each tap combination.

The travel of the disk is equivalent to about No. ½ time-lever setting on an IAC relay but can be adjusted as described in section on Adjustments. The damping magnet provides a short-time delay to prevent incorrect operation on magnetizing inrush current and on external, or through fault currents which may cause transitory differences in the normal ratio of the two currents large enough to start closing the contacts. The time curve is shown in Fig. 23.

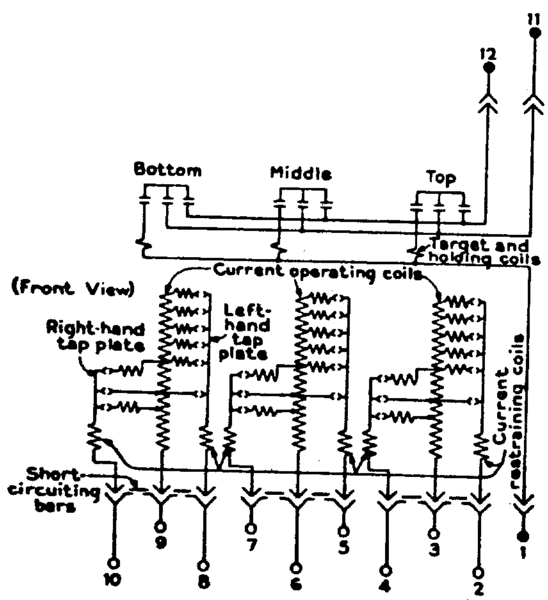


Fig. 8. Internal Connections, Type IJD14B Relay (Back View)

Contact Rating

The IJD12A contact rating information previously given applies also to these relays.

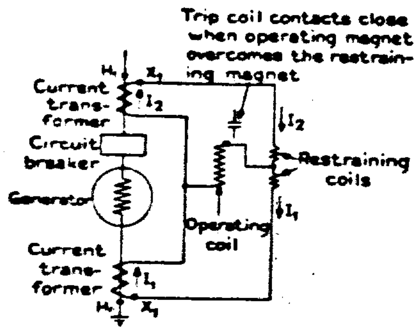


Fig. 9. Current-differential Protection with Type IJD Relay, Single-line Diagram

Volt-ampere Burdens

The normal burden on each current transformer at 5 amperes secondary current on the 3.2-amp tap at 60 cycles is 0.85–1.25 volt-amperes or 0.34 to 0.5 watt. At higher current taps the burden is still less.

These burdens are attributable mostly to the restraining coils. The normal burden imposed by the operating coil is small since the flux in the operating element is normally zero. At 5 amperes, 60 cycles secondary current the total burden imposed on one of the current transformers by the operating coil and one set of restraining coils during an internal fault will not be greater than the values given below:

Taps Used	Volt-amperes	Watts
3.2	25.2	8.2
3.5	21.0	6.9
3.8	17.8	5.8
4.2	14.6	4.8
4.6	12.2	4.0
5.0	10.3	3.36
8.7	3.4	1.1

ADJUSTMENT AND CARE

Type IJD relays are adjusted at the factory and it is best not to disturb these adjustments. If for any reason the adjustments have been disturbed, or it is desired to change them, the following points should be observed:

MECHANICAL

Disk and Bearings

The lower jewel may be tested for cracks by using a fine needle to explore its surface. If replaced by a new jewel, a new pivot should be used also. A very small drop of G-E meter jewel oil, Cat. 66X728 (or fine watch oil), should be placed on the new jewel before it is inserted.

When inserting the jewel, it should be turned up until the disk is centered in the air gap, and locked in position by the setscrew provided. The upper bearing pin support should be adjusted to permit a slight vertical end play in the shaft—about $\frac{1}{64}$ inch is enough.

The lower jewel bearing has been oiled at the factory, and the top of the disk shaft filled with vaseline. No further lubrication of any part of the relay mechanism should be attempted.

Disk Travel

The travel at the disk edge from the reset position, with the stop pin against the upper

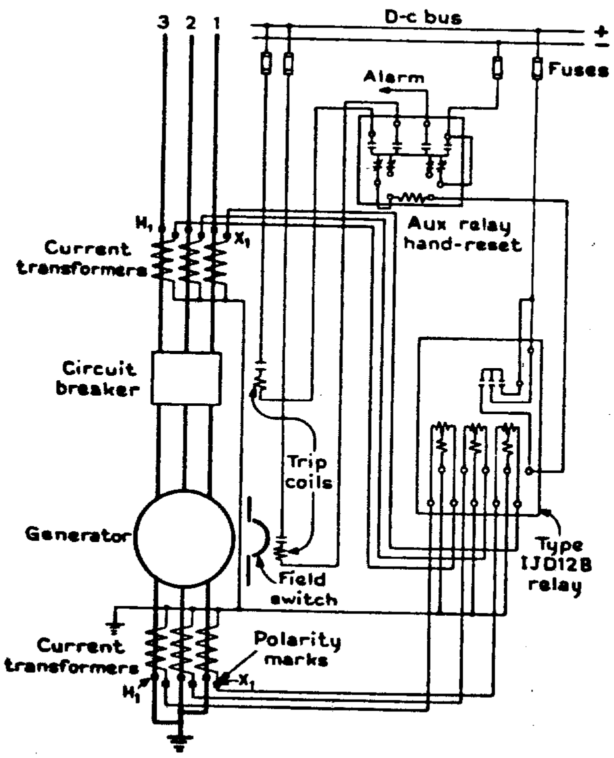


Fig. 10. External Connections, Differential Protection of Generator (Back View)

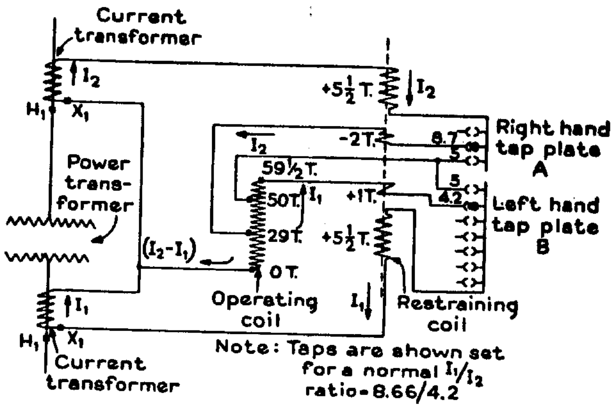


Fig. 11. Single-line Connection Diagram Showing Current Taps for Type IJD14B Relay

restraining element pole piece, to the position where the contacts just close should be about one inch. This will provide a contact separation of $\frac{1}{16}$ inch between each contact tip and the silver plate when the disk is reset. To change the disk travel, unmesh the gear by removing one of the two screws holding the contact mechanism assembly to the relay frame, and turn the gear sector one way or the other relative to the pinion. Remesh the gear and pinion as deeply as is consistent with a slight play between the teeth, and tighten down the two screws holding the contact mechanism assembly to the frame.

Contacts

If the contacts become dirty or pitted slightly they should be cleaned by scraping the surfaces lightly with a sharp knife or by using a fine, clean file. Under no circumstances should emery or crocus cloth be used on fine silver relay contacts. Finish by wiping the contacts with a clean, soft cloth and avoid touching them with the fingers. Contacts cleaned in this manner will remain in good condition for many months under ordinary conditions of service.

With the contacts just closed there should be enough space between the contact-holding armature and the poles of the target magnet to permit the fixed contact tips to be deflected about $\frac{1}{32}$ inch when the armature is finally pushed against its poles. The tips should lie in the same vertical plane. These adjustments are readily obtained by moving each contact brush with the screw in the front of the brush block which pushes against it near its middle.

ELECTRICAL

Test connections

Connections for testing various Type IJD relays are shown in Fig. 15, 16, and 17. Separate adjustment of the several currents should be possible and they should be in phase with each other. To prevent the variable inductance of the relay coils from changing the wave-form of the currents it is essential that the voltage of the testing source be at least 110 volts, and preferably 220 volts.

Use a source of good wave-form and constant frequency. Induction relays cannot be tested correctly on current of badly distorted wave-form. In this connection it should be observed

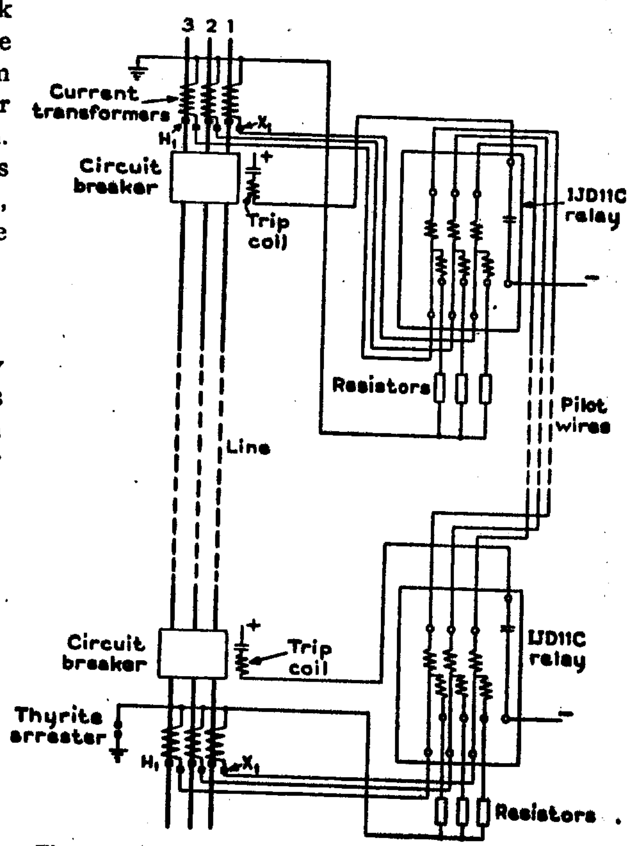


Fig. 12. External Connections, Pilot-wire Protection (Back View)

that low-voltage transformers (or phantom loads) are particularly likely to cause distorted wave-form when used for testing induction relays. A 110-volt or 220-volt source of average commercial wave-form, with the current limited by series resistance only, should result in a good commercial sine-wave-form of current.

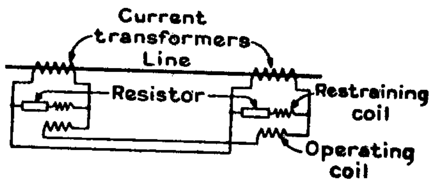


Fig. 13. Elementary Diagram for Pilot-wire Relay, Type IJD11C

Minimum Operating Current

This is the first electrical adjustment to be made. Place the operating element poles in maximum torque position. The lower shaded pole of the operating element may be rotated by means of a worm and gear mechanism by turning the adjusting screw at the left-hand side of the frame just below the edge of the damping magnet, and the torque developed on the disk varied thereby to secure the desired operating characteristics. Maximum torque is obtained when the slot in the pole face is radial with respect to the disk shaft; that is, when the shaded part of the pole is directly to the front of the relay.

The adjusting screw for the lower pole of the restraining element is at the right-hand side of the frame just below the edge of the damping magnet. The restraining element poles may be left in the position they were given at the factory or, if this is not known, they may be placed in maximum torque position for this adjustment with negligible error in the results.

Adjust the tension of the spring so that the desired minimum operating current in one circuit will just close the contacts. The spring tension is changed by slipping the spring collet on the shaft, which may be done by inserting the blade of a small screwdriver in the slot in the collet and holding the collet while the disk is turned. Care should be taken not to spread the collet and thereby weaken its grip upon the shaft.

The minimum operating current should flow in part of the restraining coil and in all of the operating coil, except in obtaining the special test characteristic for the pilot-wire relays, Type IJD11C and IJD12C, where it flows in the operating coil only. Referring to the test diagram the minimum operating current should be adjusted at I_0 and of the magnitude given on the nameplate of the relay. Also the current in I_s for the test should be zero.

Percentage Differential Characteristics

The operating characteristic curves are to be obtained next, by applying the currents given below and turning the restraining element poles away from their maximum torque position just enough to allow the disk to move very slowly and close the contacts.

Turn the lower pole in the counterclockwise direction by means of the adjusting screw, and leave the upper pole in its maximum torque position. However, if more than 30 degrees change is required, it is best to turn the upper pole also in order to keep both upper and lower poles within 30 degrees of maximum torque.

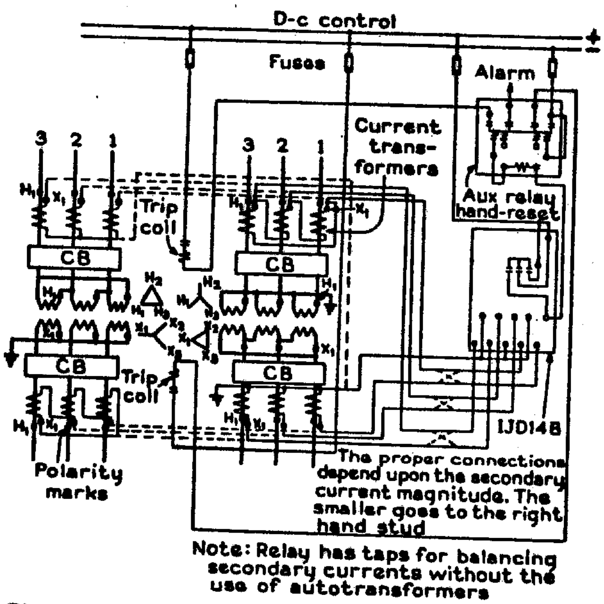


Fig. 14. External Connections for Differential Protection of Power Transformers Connected Delta-wye or Wye-delta (Back View)

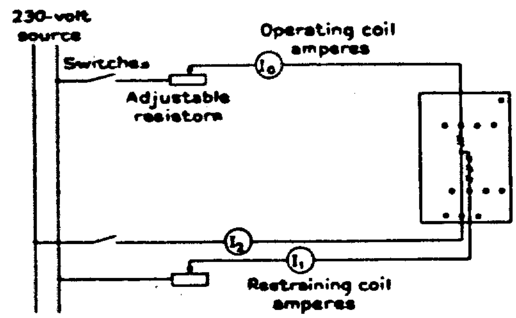


Fig. 15. Testing Connections for Middle Unit of Type IJD11C or Type IJD12C Relays (Back View)

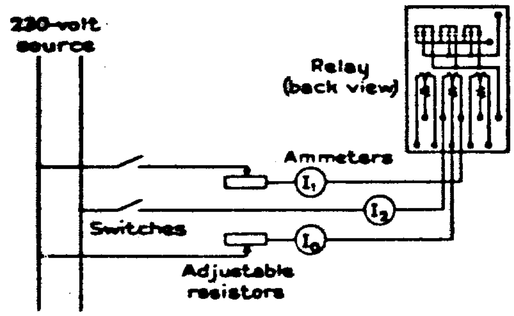


Fig. 16. Testing Connections for Middle Unit of Type IJD12B Relay (Back View)

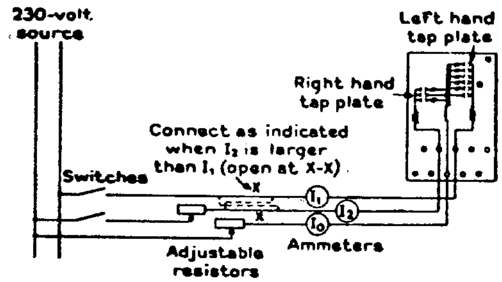


Fig. 17. Testing Connections for Middle Unit of Type IJD14B Relay (Back View)

The operating characteristic can, of course, be made different from the standard characteristics referred to above by adjustment of the operating and restraining element poles. However, a near approach to a straight-line curve can be obtained only with the poles in nearly maximum torque position, and the turns in the various coils are chosen to obtain this result with the standard characteristic.

The current values for the above adjustments are as follows: The notation I_1, I_2, I_0 refers to the connection diagrams in Fig. 15, 16, and 17. When applying large currents to the relay coils sufficient time should be allowed between tests for the coils to cool enough to avoid a damaging temperature.

Types IJD12A and IJD12B

For the percentage characteristic, Fig. 18 shows values of minimum operating current for various values of load current for a 10 per cent slope relay. Referring to the test diagram, the value of I_0 is equal to the differential current ($I_2 - I_1$) as given in Fig. 18. On relays having a 0.1-ampere minimum pickup with a 10 per cent slope make I_1 equal to 25 amp and I_0 equal to 2.5 amp. The disk should move very slowly to close the contacts.

Other examples: On relays having 1.0-amp minimum pick-up with a 10 per cent slope make I_1 equal to 40 and I_0 equal to 4.0 amp. With same minimum pickup but 25 per cent slope make I_1 still equal to 40 amp but with I_0 equal to 10.0 amp. A fourth example, on relays with 5.0-minimum pickup and 50 per cent slope make I_1 equal to 50 amp and I_0 equal to 25 amp.

Types IJD11C and IJD12C

Make I_1 in Fig. 15 equal to 40 amp and I_0 equal to 0.775 amp. This should just close the contacts for the percentage characteristic test.

Types IJD14A and IJD14B

Curves given in Fig. 21a and 21b are for the percentage characteristic and Fig. 17 shows the test circuit. Set both tap plugs for 5 amp and make I_2 equal to 40 amp and I_1 equal to 50 amp. The contacts should just close. Similar checks can be made on the other various tap settings.

If the tap settings to be used in service are known at the time of the test, the adjustment can be made on these taps according to the values given in the curves, Fig. 21a and 21b, and tests on any of the other tap combinations dispensed with. The relay is adjusted at the factory on the 5-amp taps and the operation on other tap combinations checked.

INSULATION TESTS

Type IJD relays are given an insulation breakdown test at the factory of 2500 volts, a-c, 60 cycles, sine wave, applied between each electrical circuit and the frame, and between each electrical circuit and the other.

REPAIRS

When major repairs are necessary, it is recommended that the relay be sent to the factory.

RENEWAL PARTS

When ordering renewal parts, describe the required part in detail and give the model number and rating of the relay as they appear on the nameplate.

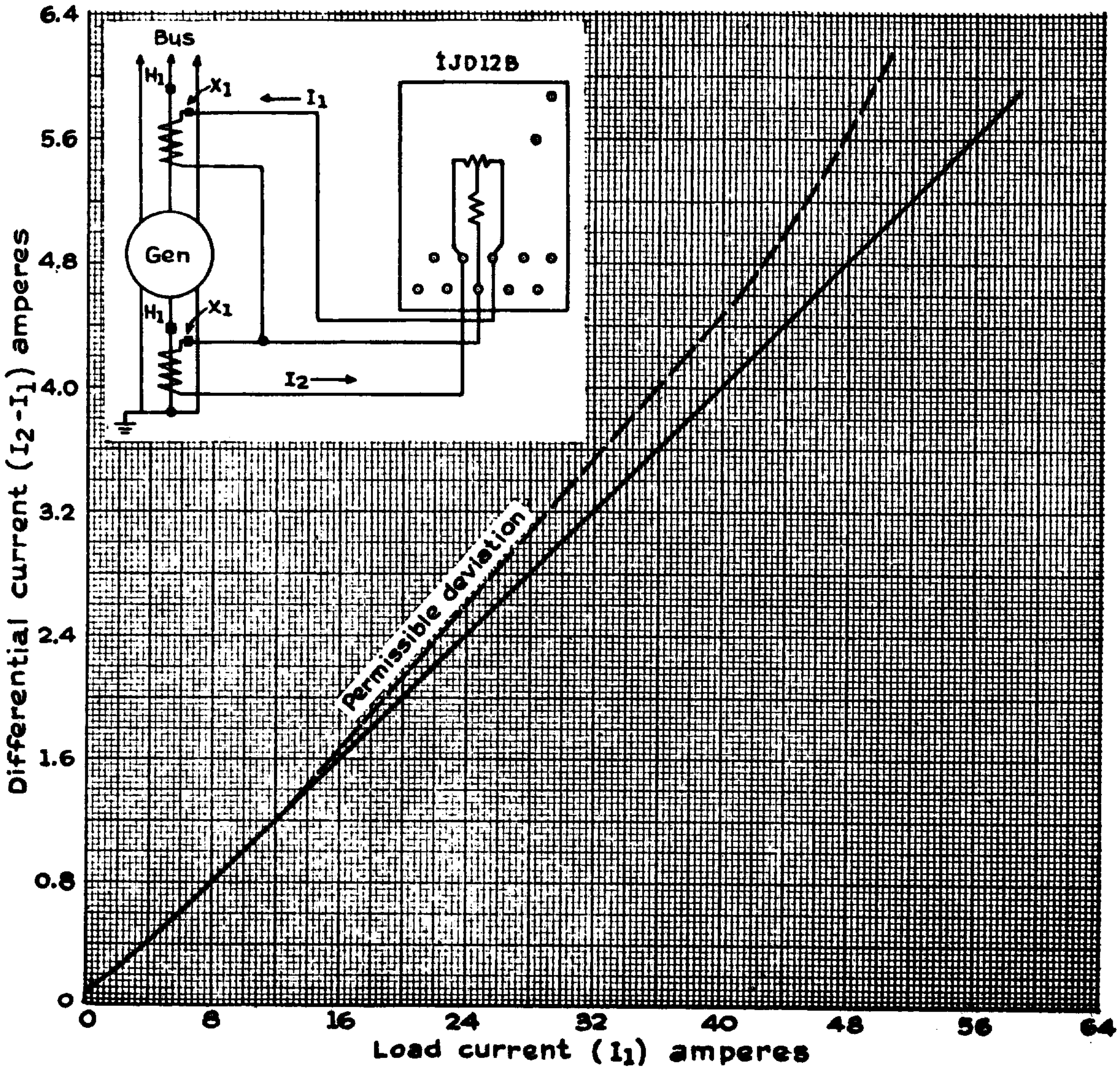


Fig. 18. Minimum Operating Current Characteristic Curve, Types IJD12A and IJD12B Relays

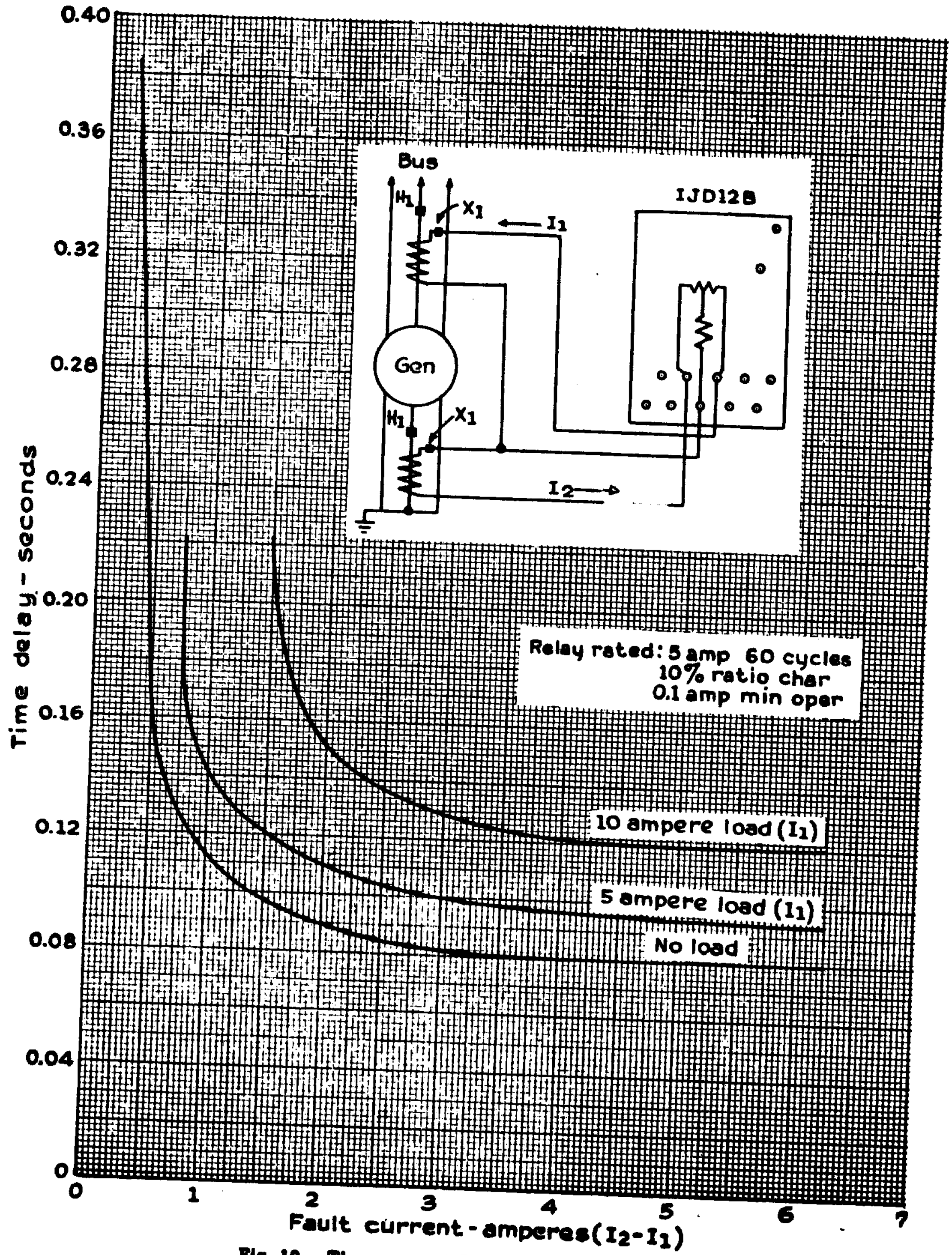


Fig. 19. Time-current Curves for Types IJD12A and IJD12B Relays

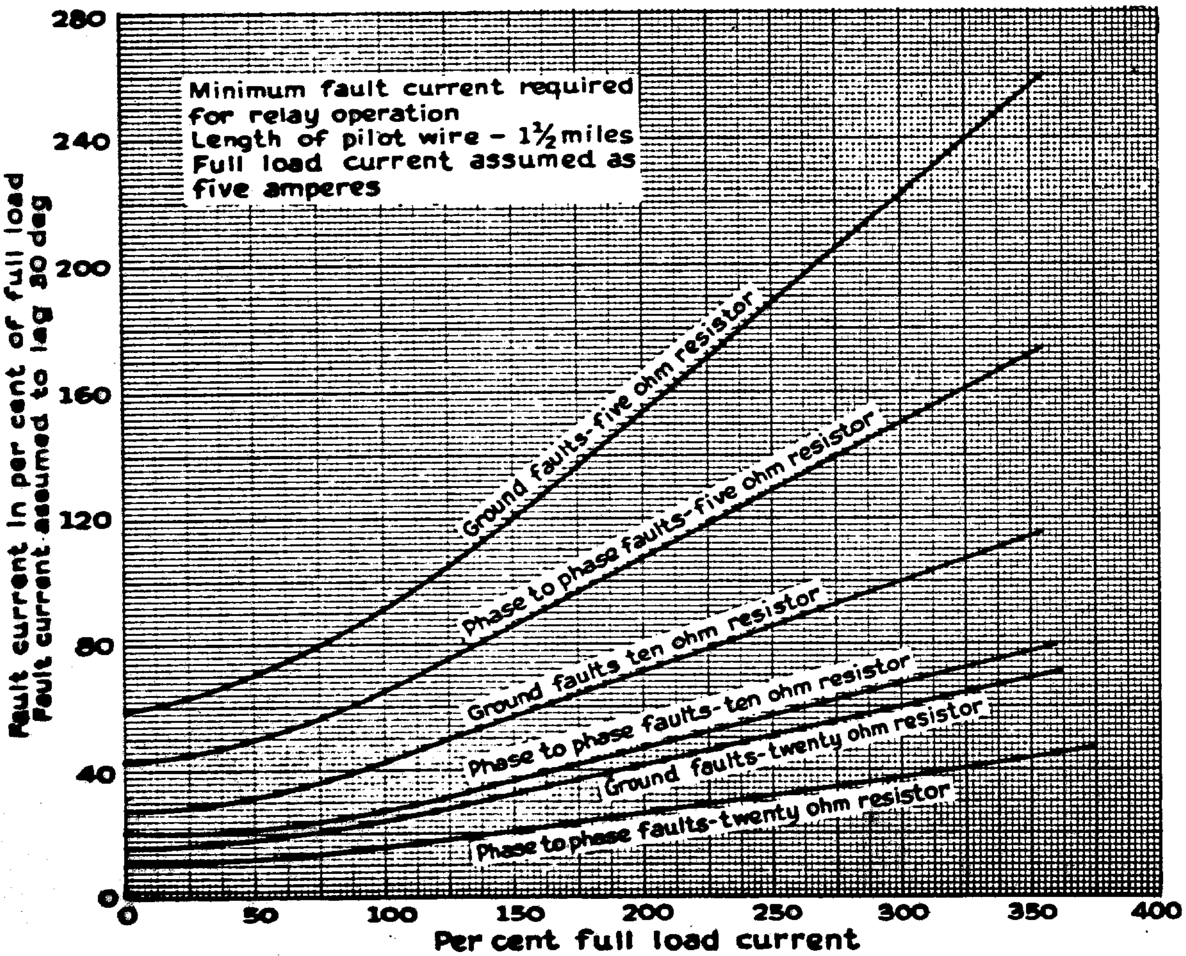


Fig. 20. Characteristic Curves for Pilot-wire Relay

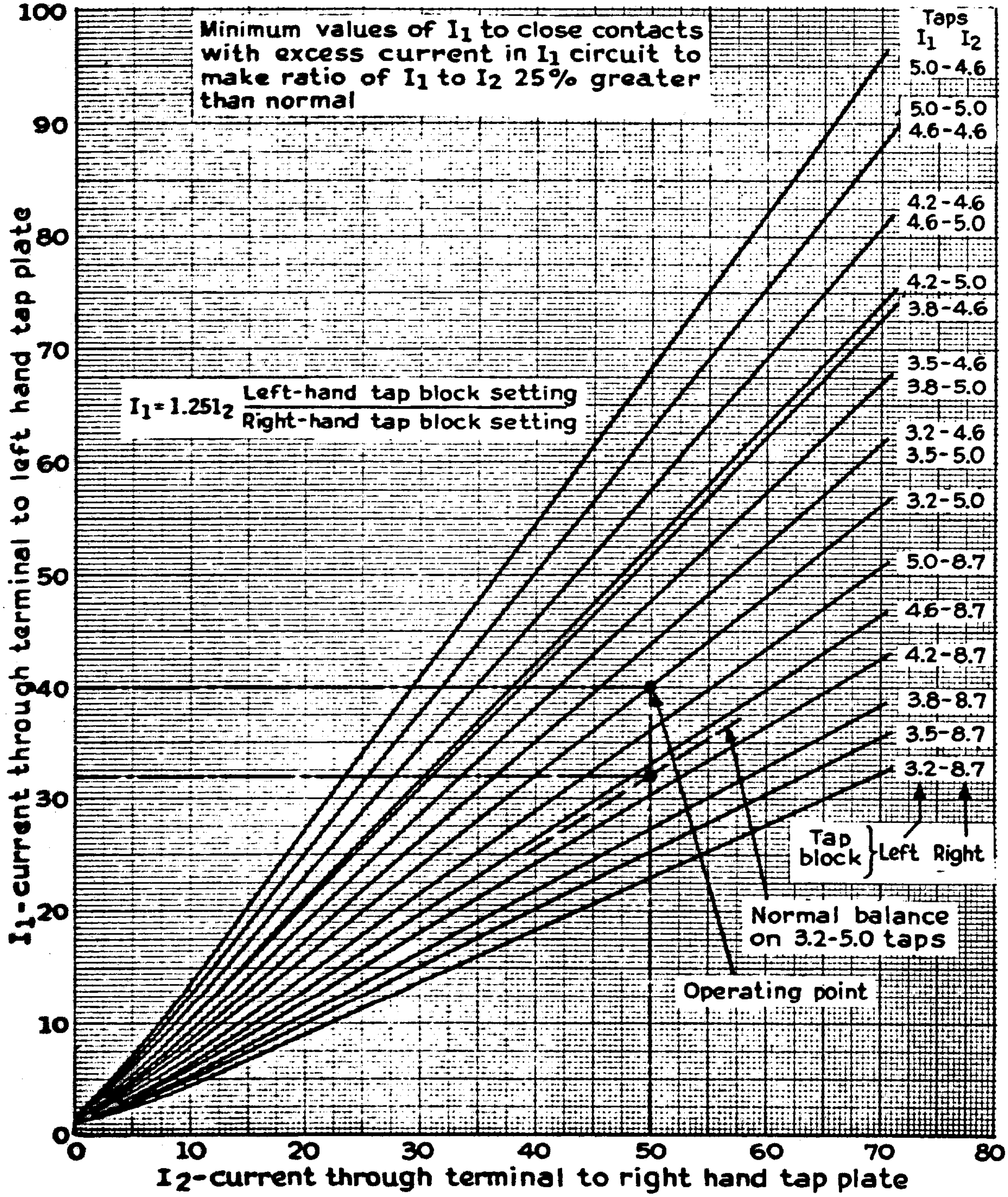


Fig. 21a. Current Differential Relay for Two-winding Transformer Protection, Type IJD14A and IJD14B Relays

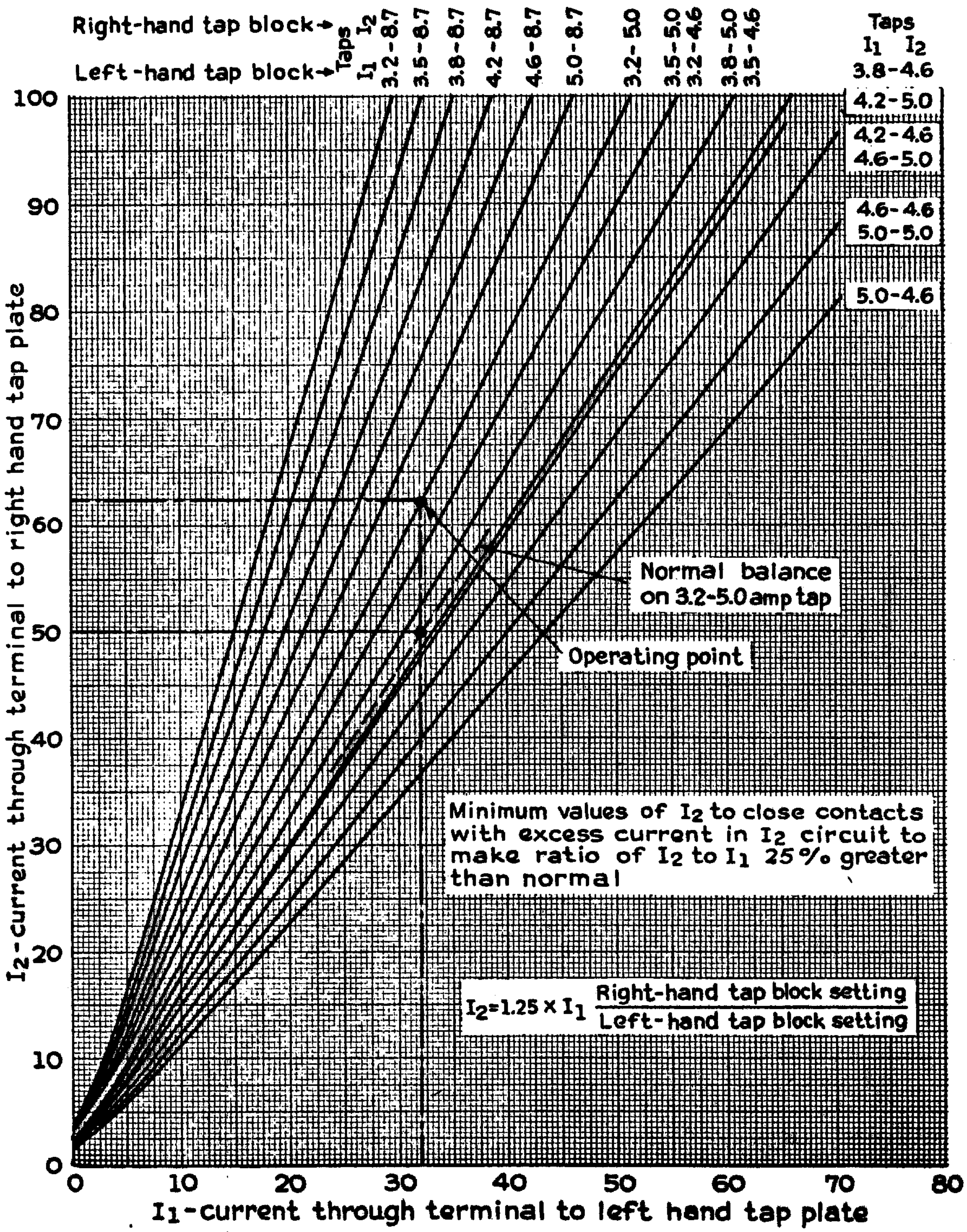


Fig. 21b. Current Differential Relay fot Two-winding Transformer Protection, Types IJD14A and IJD14B Relays

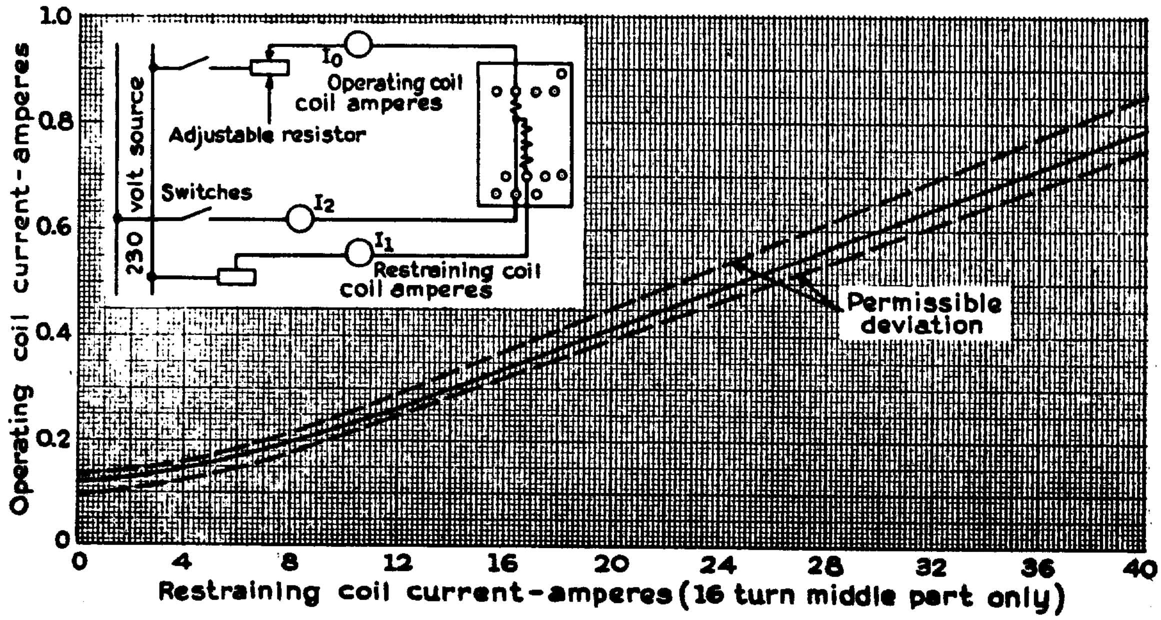


Fig. 22. Operating-restraining Current Curves to Be Obtained in Test, Types IJD11C and IJD12C Relays

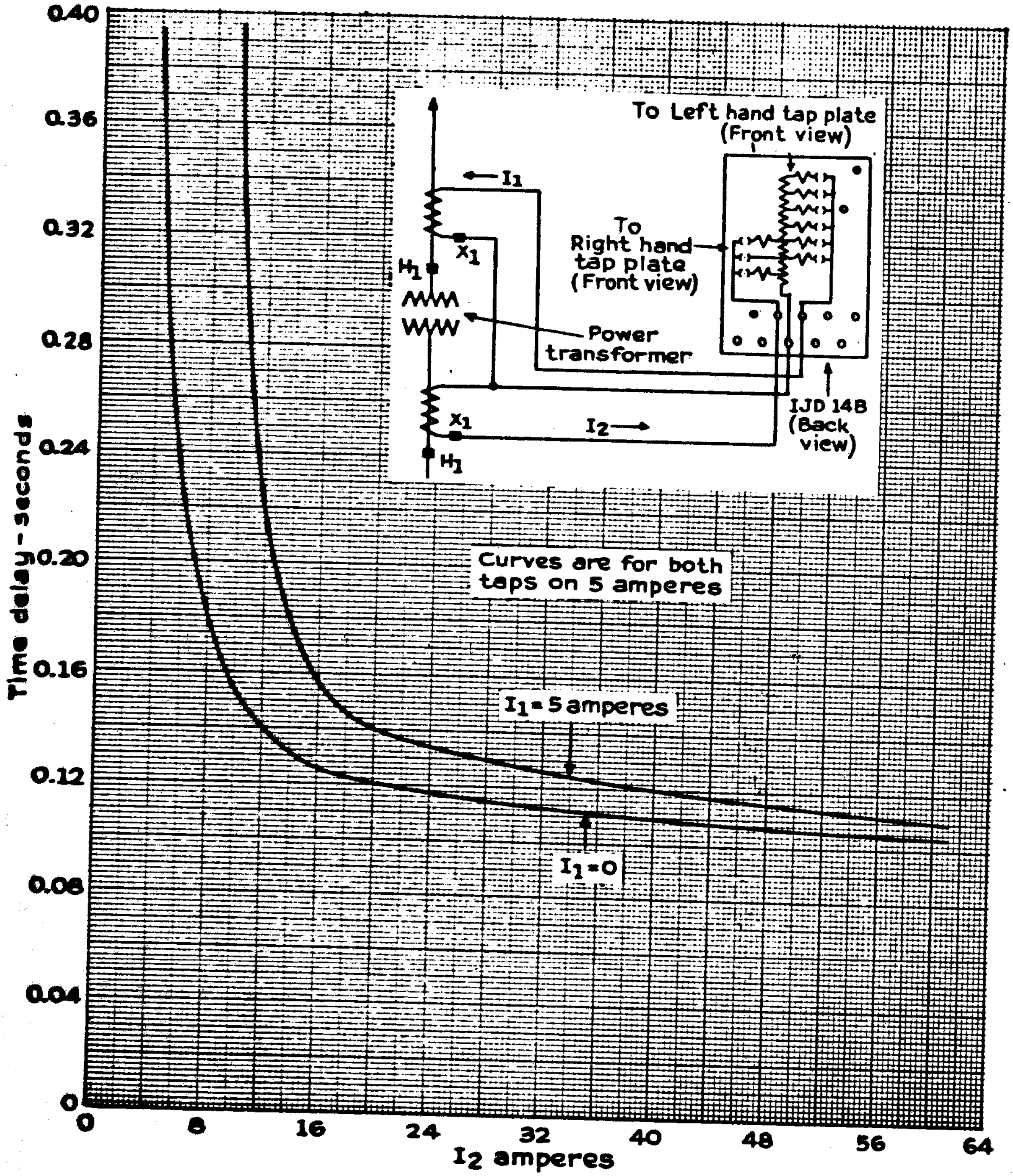


Fig. 23. Time-current Curves, Two-winding Transformer Protection, Types IJD14A and IJD14B Relays