ICM

The induction relay type ICM2 is used to protect lines and equipment against short circuits by obtaining suitable correlation between tripping current and time setting in each location. It consists of three elements: an induction-disc inverse time relay, an instantaneous trip device and a contactor. Due to its unusually narrow design, space requirements on the panel are reduced.
The relay can be taken from its housing single-handed, without interrupting the current circuit.
The time-current characteristic is defined by a single-line curve.
The instantaneous trip device is energized from the induction element magnet, obviating a separate coil. The range of adjustment is unusually large.
All contacts and adjustments are located in the front part of the housing and are thus easily accessible.
All bearings are of stainless steel and free of oil. The relay therefore requires no maintenance.
The relay can also be supplied with very inverse characteristic (Type ICM22).

Relay for semi-flush mounting

Design and Operation

Testing

Adjustment

Characteristics

Circuit Diagrams

BROWN BOVERI

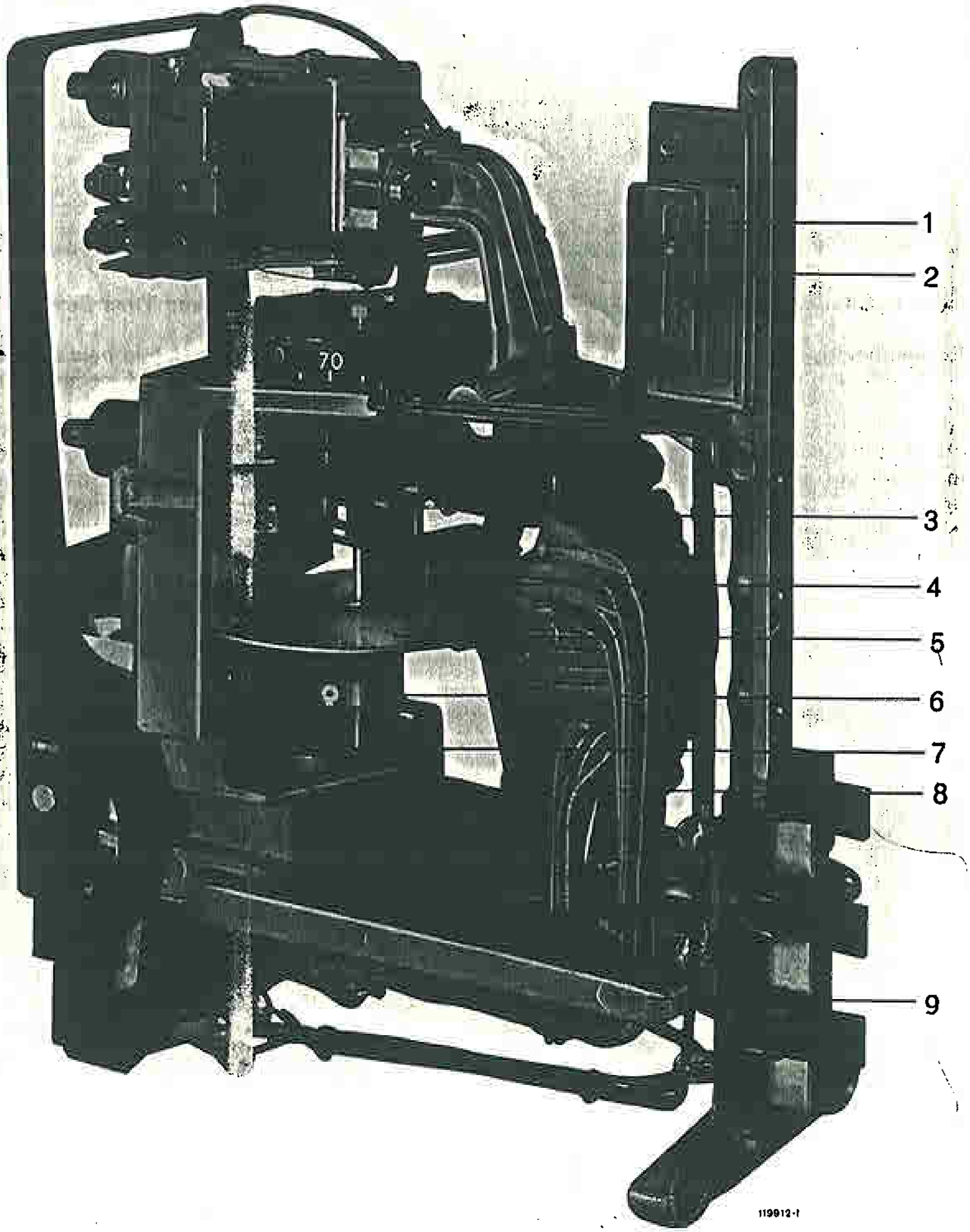


Fig. 1 Side view of type ICM2 relay removed from housing

1 Slide for adjustment of current
2 Scale for marking factory adjustment of slide
3 Arms of magnetic induction circuit
4 Pole pieces of magnetic induction circuit
5 Induction disc
6 Cam producing constant spring torque
7 Ribbon
8 Spring
9 Slides for guiding into housing

Magnetic Circuit

The magnetic circuit is an entirely new design permitting the use of an unusually small disc. By proper dimensioning and shaping of the magnetic circuit 3 and 4 (Fig. 1), the average length of the saturated portion of the field lines is controlled so as to produce the desired current-time characteristics with abundant torque. The difference between the inverse and very inverse time relays lies in the dimensioning of the magnetic circuits. With slide 1 the pick-up current can be accurately adjusted. Once established, the correct slide position is marked on scale 2.

Induction Disc and Time Setting

The induction disc 5 is held back by a coil-type main spring 8. The resultant torque is maintained constant over the full travel of the disc by attaching the coil spring to the disc by means of a Mylar ribbon 7 wound on a cam 6. The change in radius of the latter applies the necessary correction to the spring characteristic. The ribbon is loaded to not over 2% of its breaking strength and has been tested over a temperature range of —40 to +100° Centigrade. The other end of the spring is fastened to a bi-metal arm 20 (Fig. 2) with pointer 22, which offsets temperature effects. The constant-torque design described above results in constant speed of the disc with a given current as determined by the damping magnet 18, so that the tripping time is in exact linear proportion to the angular travel, i.e. the time setting. In consequence, the time-current characteristics of the relay are obtainable from a single curve established with maximum time setting (100% on the time dial), by multiplying the time reading by the percentage set on the dial. However, for easy reference, we have also indicated time-current curves for various time-dial settings in 10% steps, as may be seen in Fig. 8-12.
The induction-disc shaft runs in a spring-floated miniature ball bearing at its lower end and in a jewel at the top. Shaft and bearings are of stainless steel and require no lubrication or maintenance.

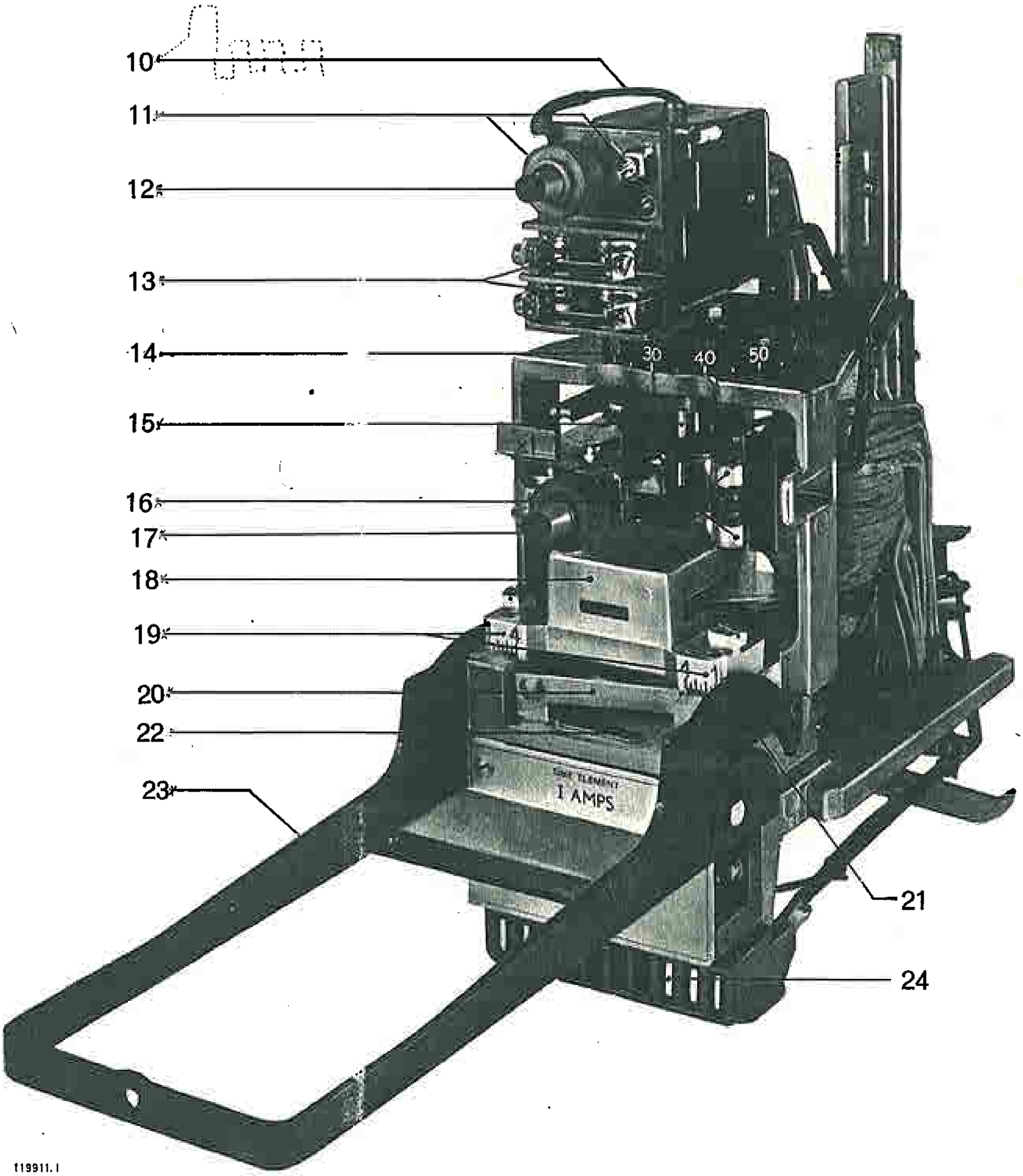


Fig. 2 Front view of type ICM2 relay removed from housing

10 Connection to tap terminals
11 Tap terminals of auxiliary contactor coil
12 Signal button of auxiliary contactor
13 Contacts of contactor
14 Dial for time setting
15 Floating contact pin
16 Stationary contacts of induction element
17 Signal button for instantaneous element
18 Damping magnet
19 Adjusting scales of damping magnet
20 Temperature compensating arm
21 Curved slots of drawout bracket
22 Adjusting lever for spring 8
23 Drawout and carrying bracket
24 Test connections

Damping Magnet

The damping magnet 18 is a die-casting with two high-grade Ticonal magnet inserts resulting in efficient damping unaffected by surroundings and time. The adjustment of the magnet position is accurately indicated on scales 19.

Contacts

The relay contacts are of the self-aligning bridge type. The moving part 15 is a solid silver pin, flexibly attached to the rotary arm. The stationary contacts 1 consist of solid silver buttons with individual screw adjustment.

Current Setting and Field Coil

The pick-up current range can be selected by a seven-position rotary snap switch (Fig. 4), inserting the proper number of field coil turns. The switch always makes before it breaks. A change in current setting can therefore be made safely without removing the relay from service. The switch contacts are of the non-oxidizing high-pressure type. Both field coil and associated contact devices can permanently withstand the currents marked on the rotary switch. They form a unit which can be easily replaced.

Instantaneous Trip Device

The armature 25 (Fig. 3) of the instantaneous trip device is subjected to the leakage field of the induction element. The tripping range is adjustable from 2.5 or ... to 10 times the current selected on the rotary switch by means of dial 28. Operation of the instantaneous trip device is recorded by signal button 29. On position ... the instantaneous trip is cut out.

Auxiliary Contactor, Connections and Signals

The auxiliary contactor is equipped with two double-break contacts 13 and a signal button 12. The contactor coil is either a series coil, in series with the trip coil, or a voltage coil.
The series coil, see circuit diagram Fig. 15, connected to one contact instantly relieves the induction disc and instantaneous trip contact from carrying the tripping current which is subsequently interrupted by a contact on the breaker mechanism. The coil is tapped for trip-coil currents of 0.2 to 2 A and 1,2 to 20 A. The connection 10 should be made to the proper coil terminal 11 before energizing the relay.
When used with voltage coil (Fig. 16) the disc and instantaneous contacts energize the contactor coil only and one of its contacts energizes the trip circuit. In both circuit diagrams the free contact can be used for other purposes, such as double-pole tripping, signalling, etc.
Contacts and coil of the auxiliary contactor can be replaced without removing the contactor itself.

In addition to the circuits shown in the above two diagrams, the relay can, if desired, be connected in accordance with special requirements. It is also possible to install two auxiliary contactors side by side.

In the four standard circuit diagrams Fig. 17-20, the pick-up of the auxiliary contactor operates signal button 12 "T" regardless of whether it is initiated by the induction disc or instantaneous trip device. If the breaker is tripped by the instantaneous element, signal button 17 "×I" shows as well. Both signals are reset from outside the housing by their buttons.

Housing

The relay is contained in a dust-proof housing convertible for semi-flush or surface mounting, normally back-connected (Fig. 21 and 22). Front connection is available if required.

Drawout Device

The relay is very easily removed from its housing during service. When the drawout bracket 23 (Fig. 2) is fully lowered, the curved slots 21 engaging in the stationary pins attached to the housing force the relay slightly forwards. As a result, first the current-transformer circuit is bridged by the short-circuiting device 31, then the moving contacts 32 are withdrawn from the stationary clips 30. The leverage of the bracket allows this movement to be performed without effort. The relay is now completely free on its guiding slides 9 (Fig. 1) and can be lifted out, using the bracket as handle. The back of the housing is removable by loosening two screws on either side. This makes the stationary contacts and the short-circuiting device fully accessible (Fig. 5).

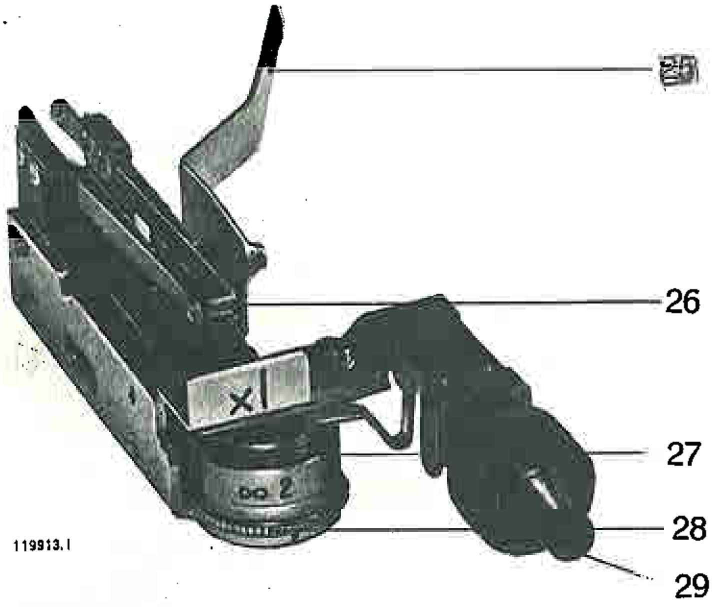


Fig. 3 Instantaneous trip element

25 Armature
26 Closing contact
27 Coil spring
28 Dial with adjusting knob
29 Signal button (17 Fig. 2)

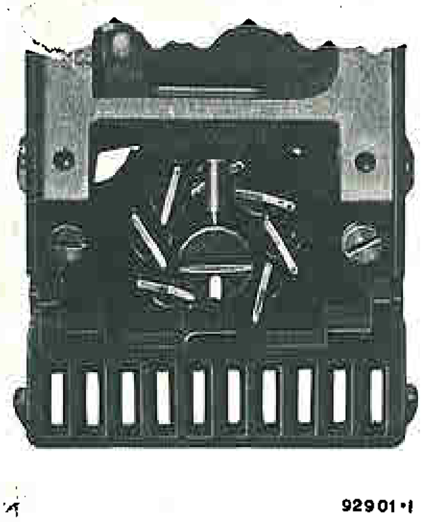
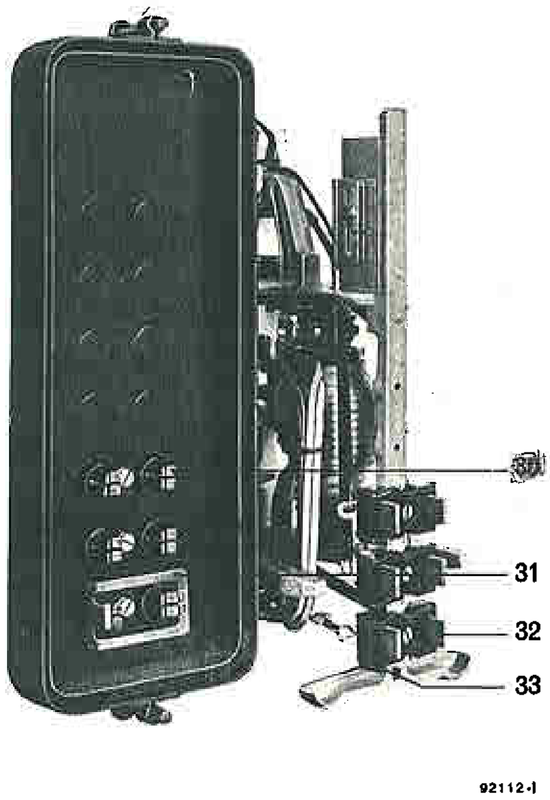


Fig. 4 Rotary selector switch for current-setting (face plate removed)

Fig. 5 Arrangement of drawout contacts

30 Stationary clips
31 Short-circuiting device
32 Moving contacts
33 Block for opening short-circuiting device



General

The relay is so designed that, apart from the usual periodical check, no maintenance is necessary. The factory settings as described on page 10 should not be changed. When a correction, for instance due to mishandling or dismantling, proves necessary, the relay should be returned to the factory. In the case of emergency, possibilities of adjustment exists as outlined below. Calibration should be made with normally cool windings and sinusoidal wave-shape.

For testing, the relay can be removed from its housing and checked with a relay testing set suitably connected to a spare housing. For testing in this manner the relay will not be provided with testing contacts. For measuring current and time the relay must be in a housing. Only when adjustments have to be made may it be withdrawn.

For checking in place, the relay can be furnished with test connections 24 (Fig. 2). A plug with cable (Fig. 7) is used for testing. This plug is inserted while the relay is in the operating position. Swinging down the draw-out bracket first opens the sliding contacts and then engages the prongs of the plug (Fig. 6). Lowering or raising the bracket switches over from the operating to the testing position or vice versa; thus the time during which the relay is out of service is reduced to a minimum. The plug cannot be withdrawn before the bracket is reset in its operating position.

Fig. 6 Relay with plug in test position
Fig. 7 Test plug with spring contacts and cable

Adjustment of Contacts

By means of screws the stationary contacts 16 of the induction element (Fig. 2) are adjusted so that the contact pin 15 of the disc arm is vertical and just touches them when the time dial is set to zero.

Adjustment of Pick-up Current

Set selector switch to lowest value and time dial to 100%. The pick-up current is that current which for relays ICM2 and ICM22 just causes the disc to turn until contact closes; for relay ICM21 until the disc just returns from contact closed position to the stop.
Small correction may be obtained by means of the pointer 22 (Fig. 2); this however has an adverse effect on the fall-back ratio.
Larger errors must be corrected by moving the slide 1 (Fig. 1) upwards for increasing pick-up current, but this correction has some influence on the relay characteristic.

Adjustment of Timing

Set selector switch to lowest value and time dial to 100%. Pass 10 times the current indicated on the selector switch through the relay and adjust the time by sliding the damping magnet along the slots. The magnet position can be traced on the two scales 19 (Fig. 2). Check tripping time against time-current curve by means of a frequency counter. Make sure wave-shape of current is not distorted.
This adjustment covers all points on the current-time curve.

Adjustment of Instantaneous Trip Device

The scale marking 28 (Fig. 3) is individually made in the factory with black ink. Should correction be necessary, the long upper end of the coil spring 27 must be bent slightly forward or backward, accordingly.

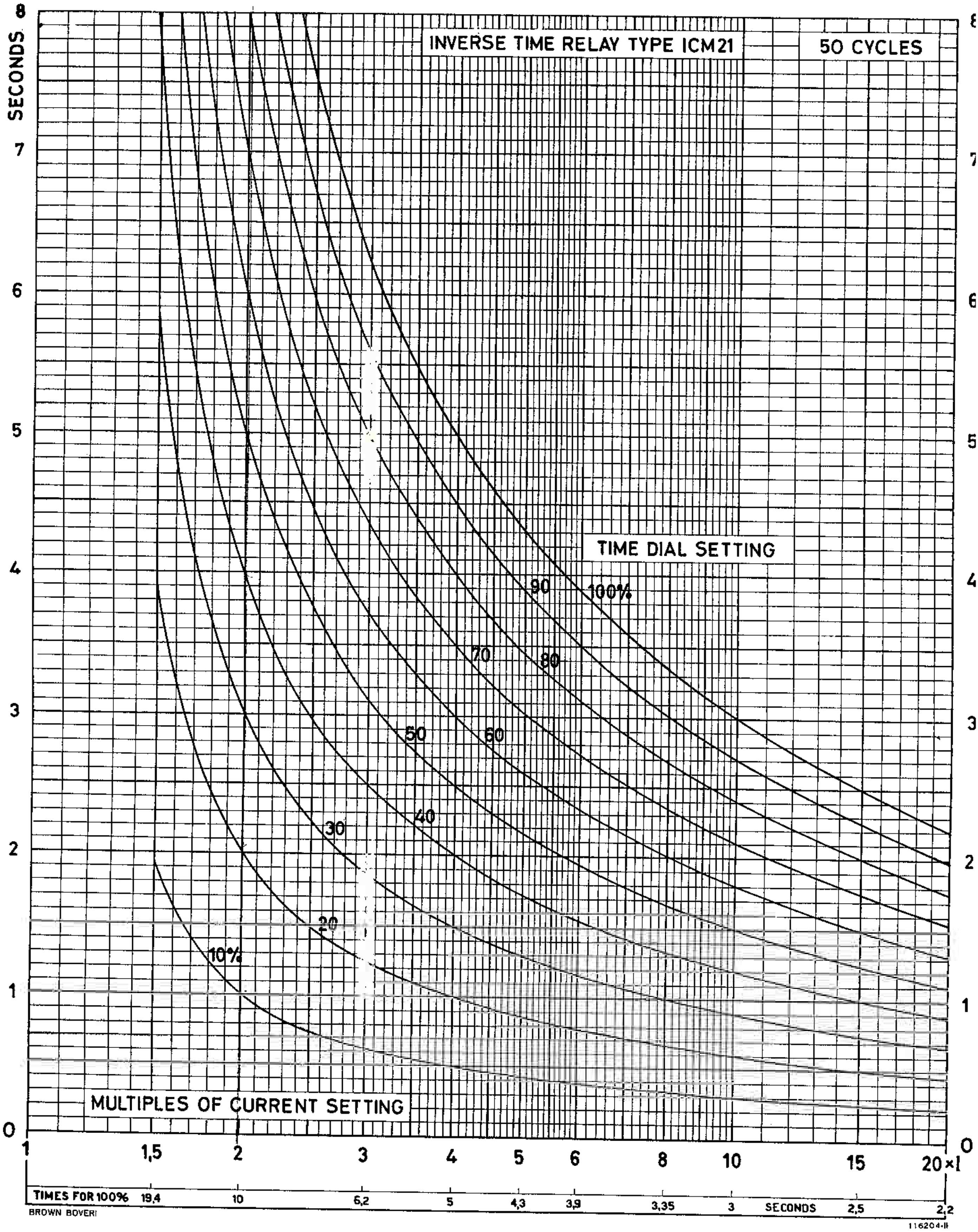


Fig. 8 Time-current characteristics of inverse time overcurrent relay type ICM21, in accordance with British Standard 142

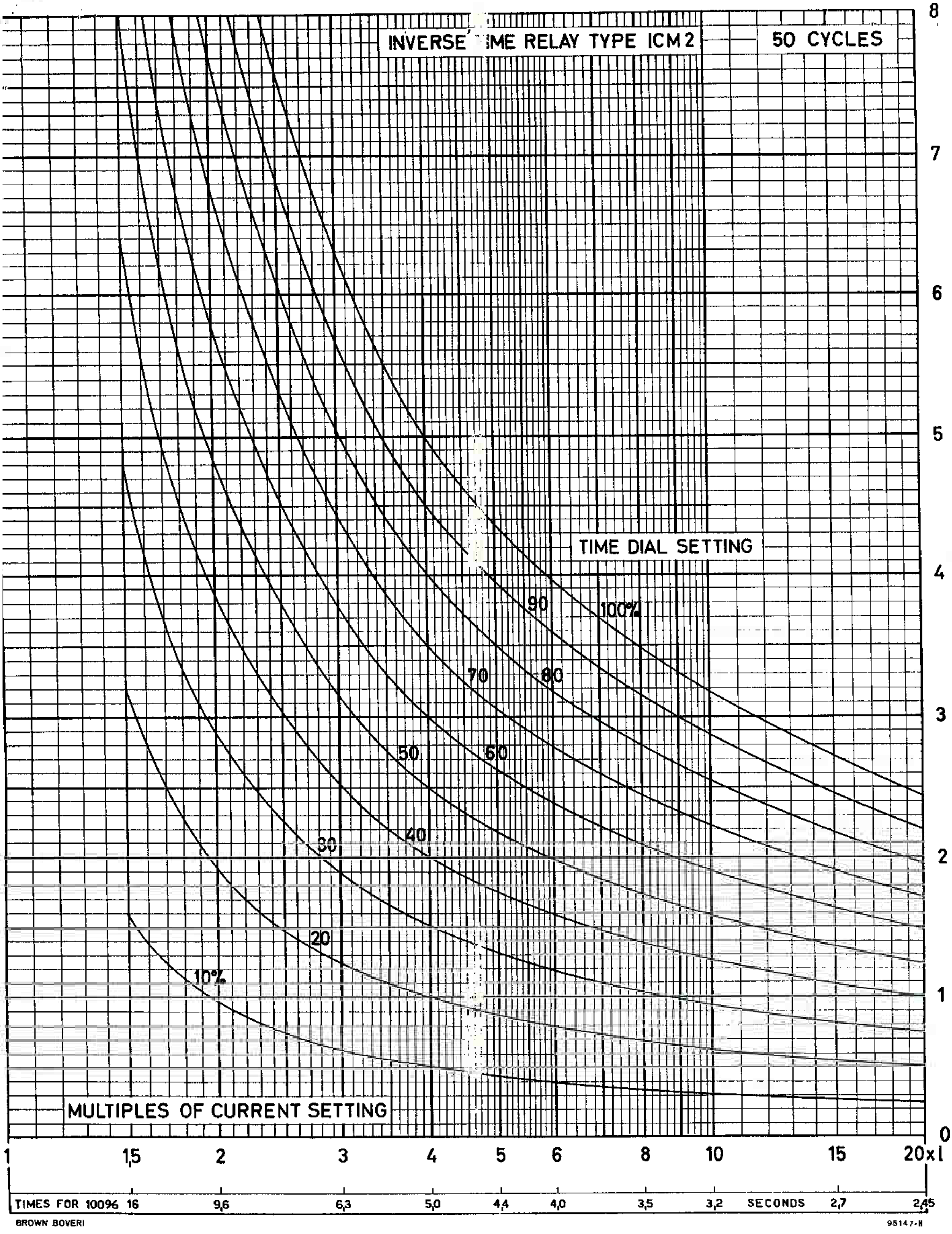


Fig. 9 Time-current characteristics of inverse time over-current relay type ICM 2—50 c/s

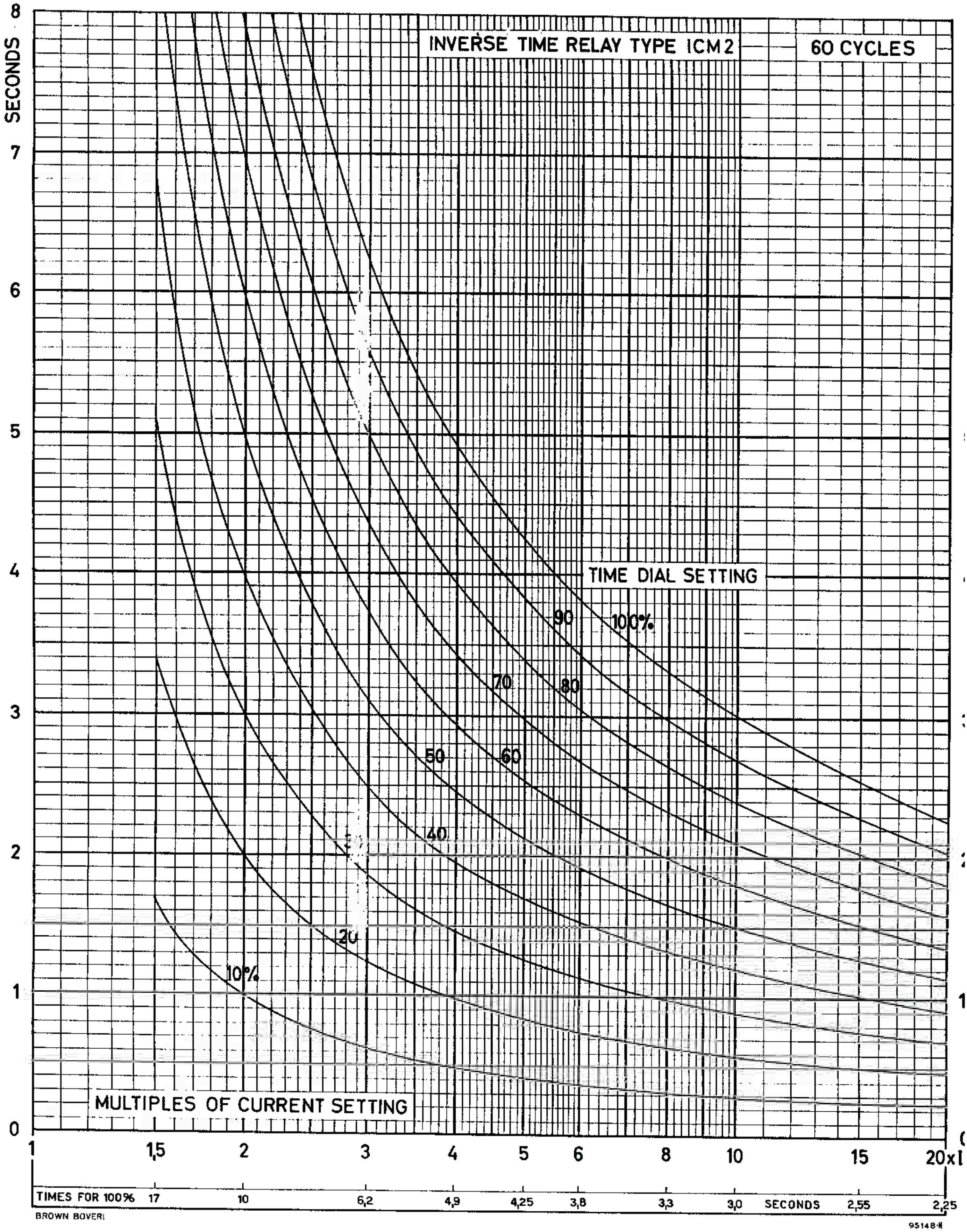


Fig. 10 Time-current characteristics of inverse time overcurrent relay type ICM 2—60 c/s

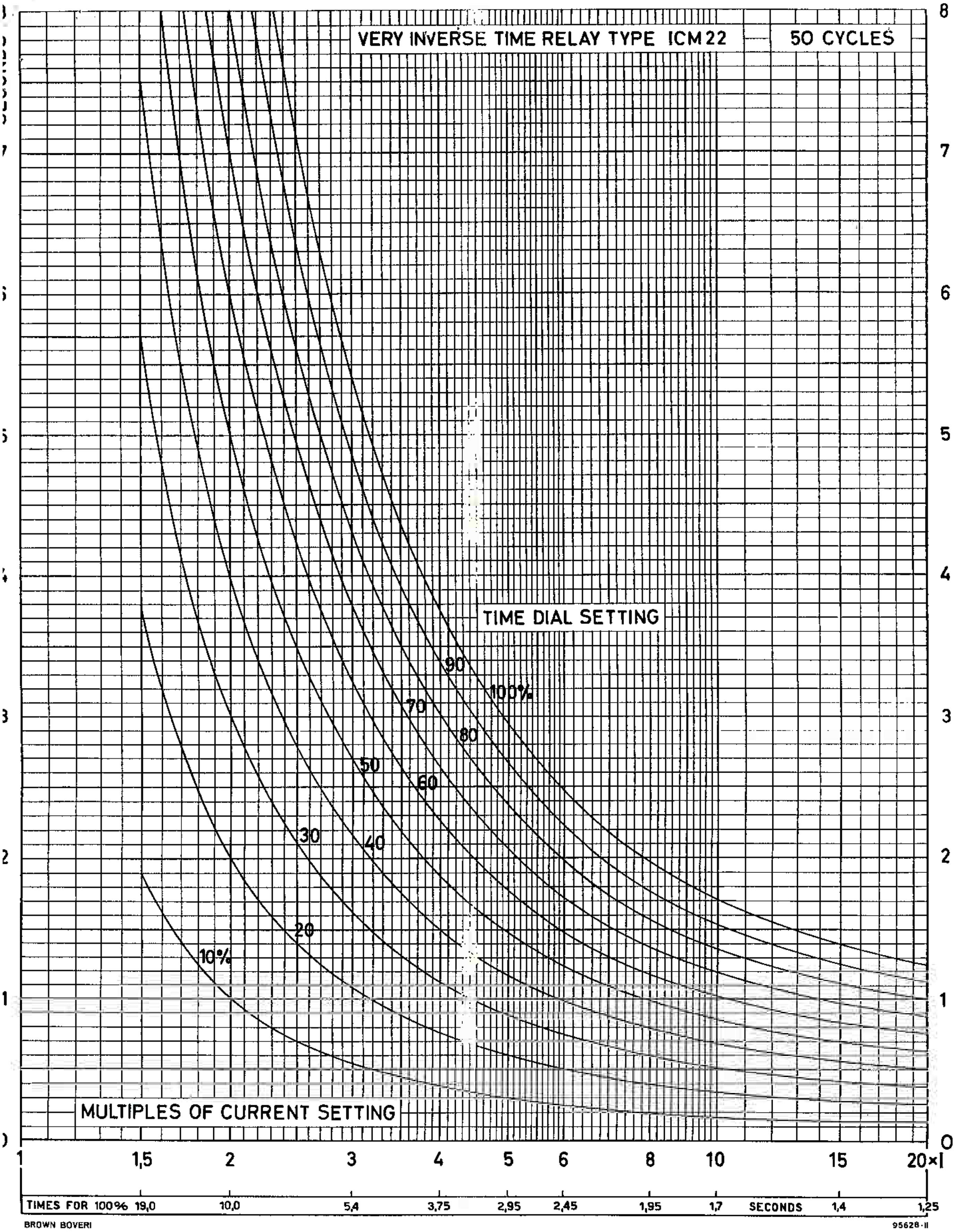


Fig. 11 Time-current characteristics of very inverse time overcurrent relay type ICM 22 — 50 c/s

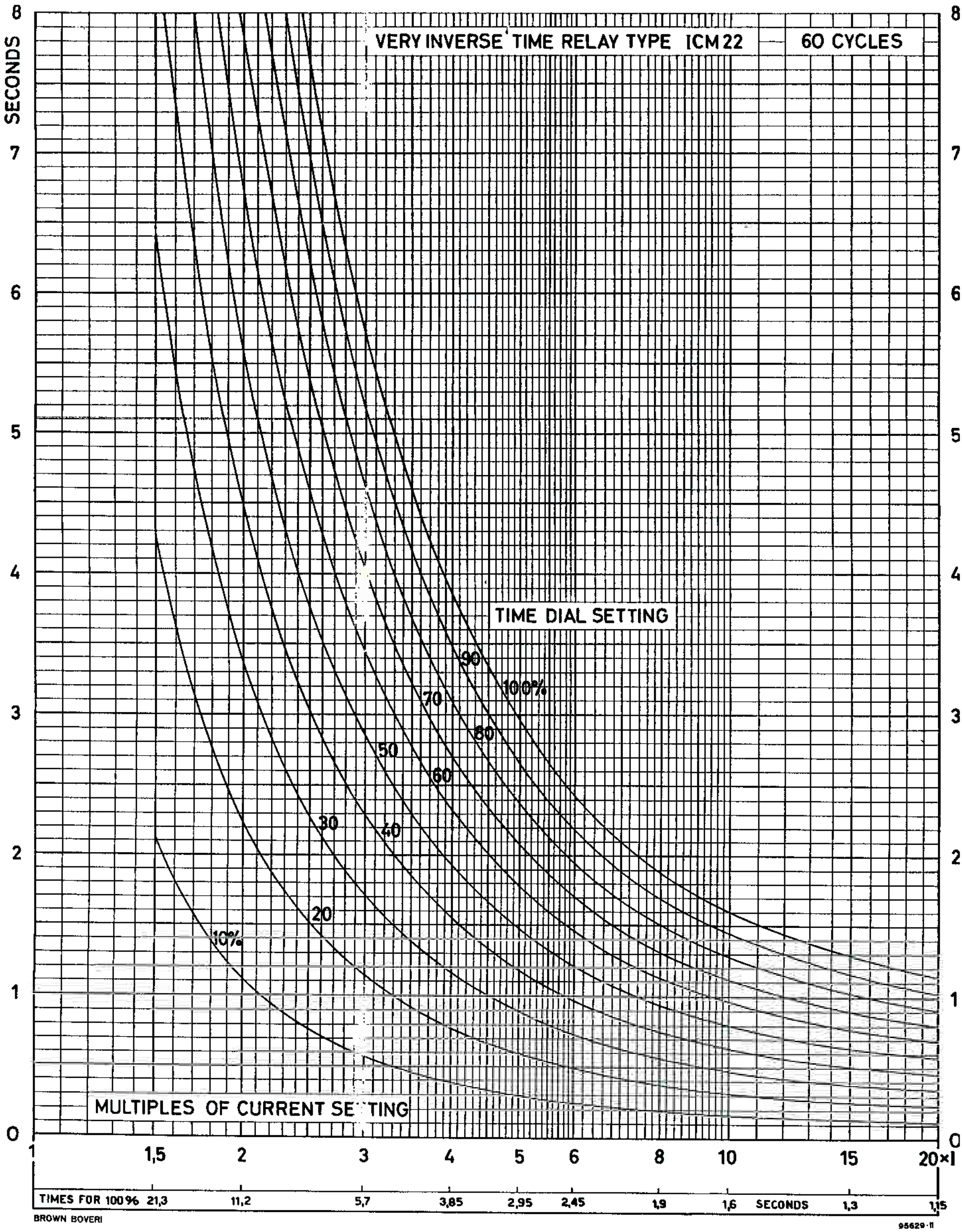


Fig. 12 Time-current characteristics of very inverse time overcurrent relay type ICM 22—60 c/s

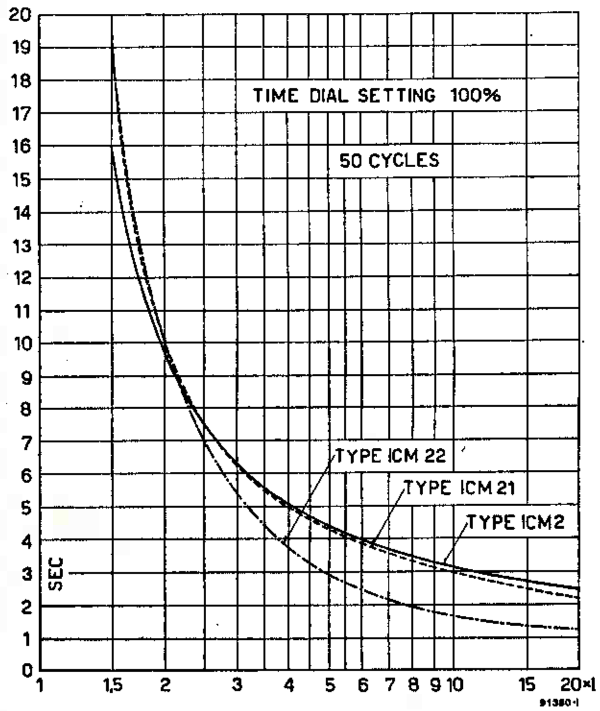


Fig. 13

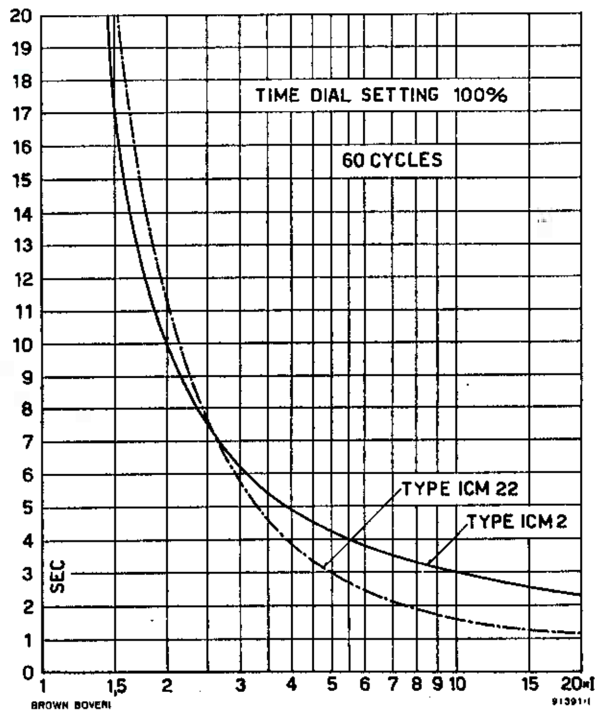


Fig. 14

Comparison of relay time-current characteristics for time setting 100%:

Type ICM2: With inverse time curve
Type ICM21: With inverse time curve (British Standard 142)
Type ICM22: With very inverse time curve

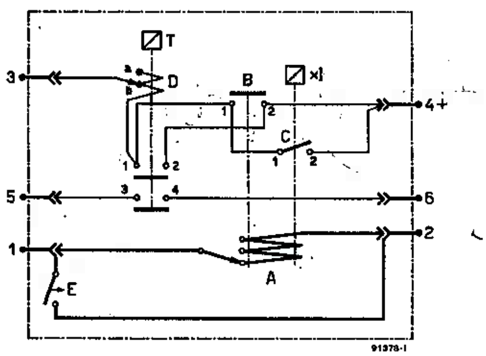


Fig. 15 Internal circuit, relay with series coil contactor

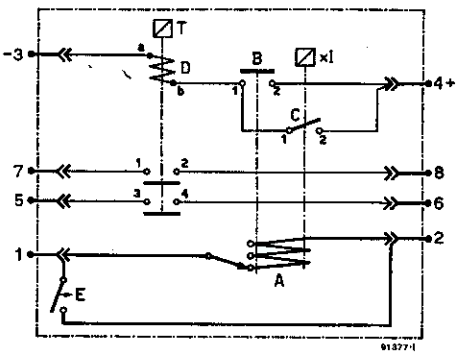


Fig. 16 Internal circuit, relay with voltage coil contactor

A Current coil
B Time contact
C Instantaneous contact
D Auxiliary contactor
E Shorting switch
T Signal button
xl Signal button

Besides these standard circuits, others are available on application

Fig. 17 Circuit diagram for three-phase short-circuit protection
Relay with series coil contactor

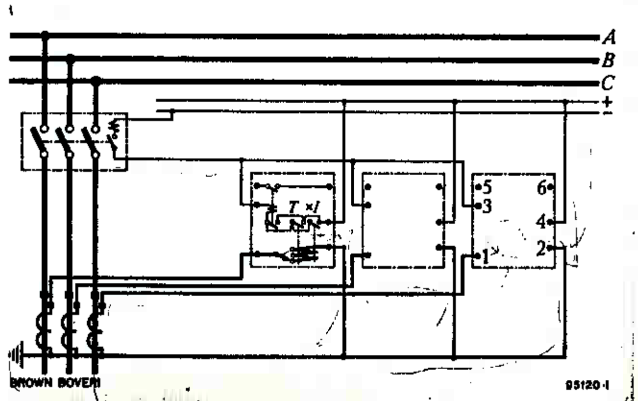


Fig. 18 Circuit diagram for three-phase short-circuit with separate ground-fault protection
Relay with series coil contactor

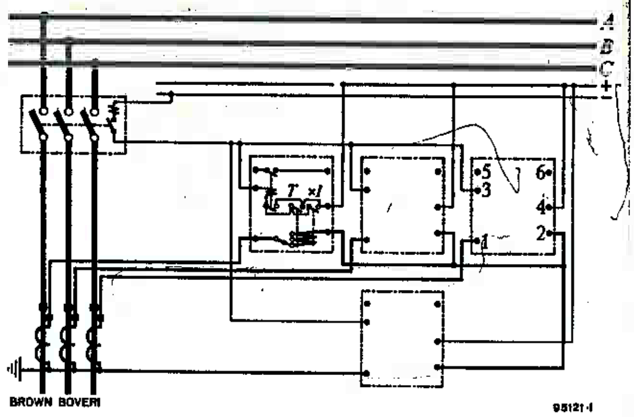


Fig. 19 Circuit diagram for three-phase short-circuit protection
Relay with voltage coil contactor

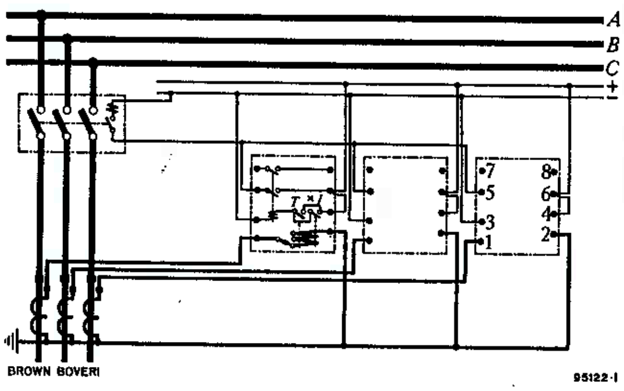
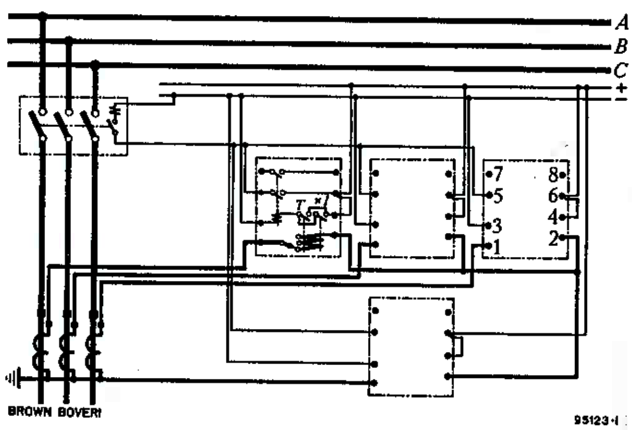
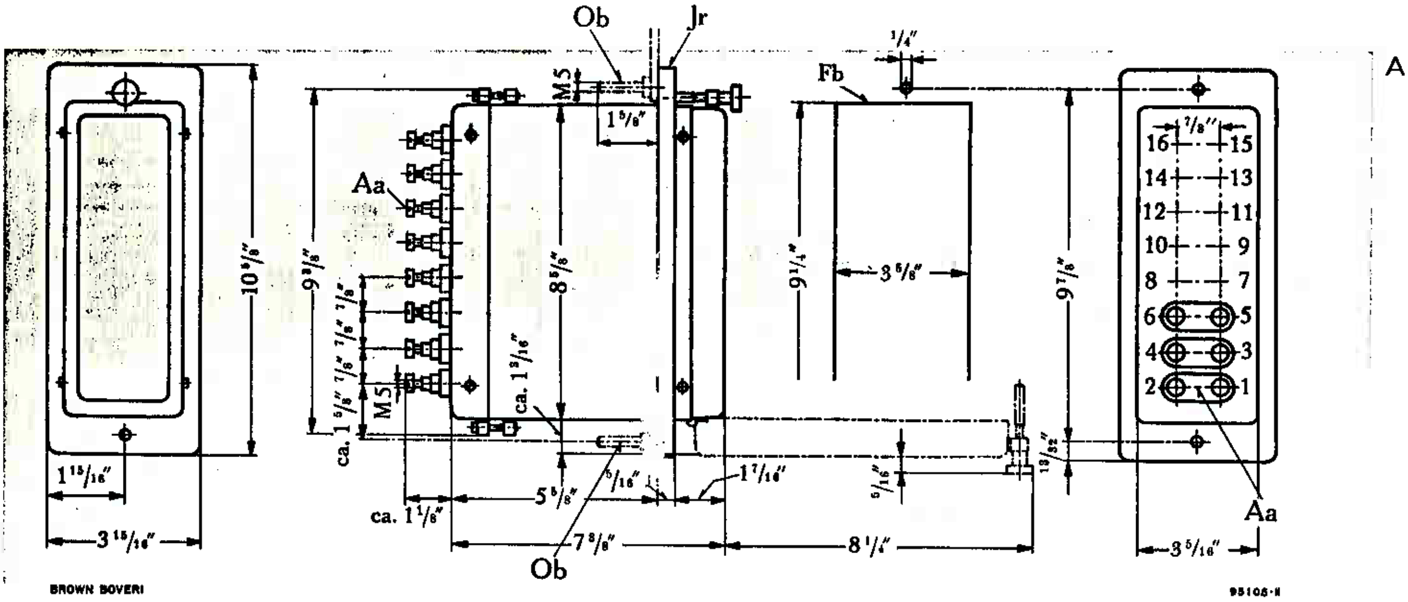
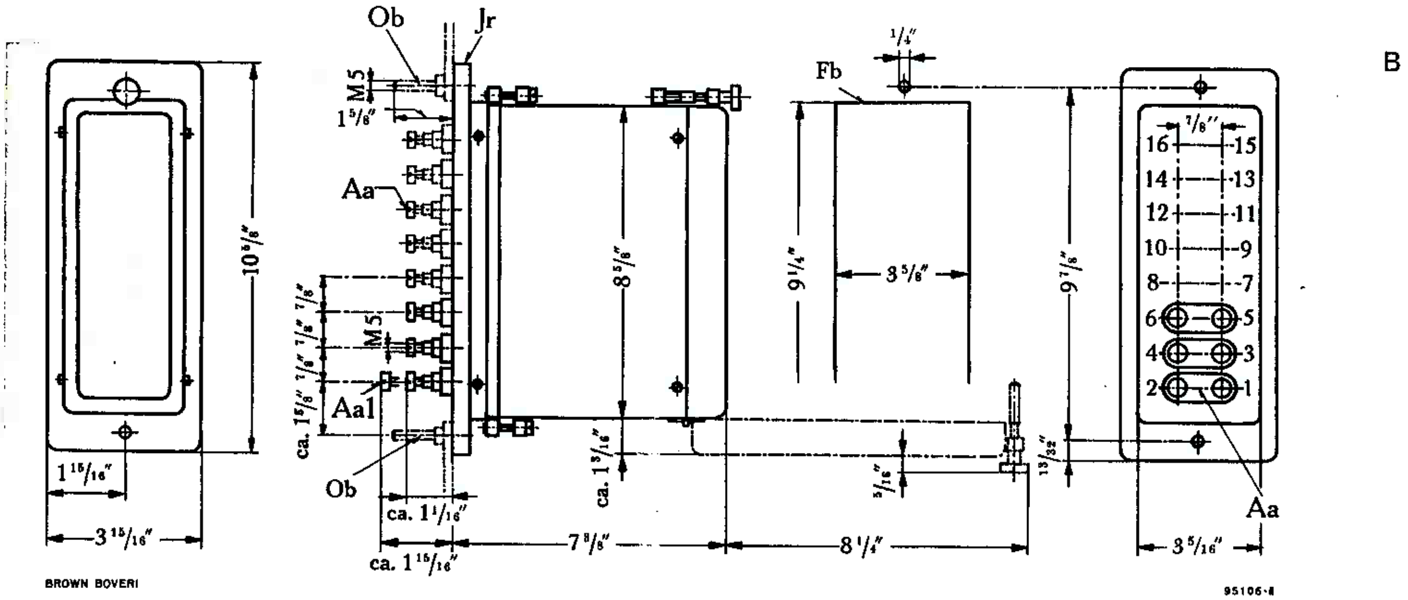


Fig. 20 Circuit diagram for three-phase short-circuit th separate ground-fault protection
Relay with voltage coil contactor







A Fig. 21 Semi-flush mounting
B Fig. 22 Surface mounting

Aa, Aa1	Terminals
Jr	Fixing frame
Ob	Fixing screws

Induction Disc Element

Normal current range	Available tap settings in A						
4/16 A	4	5	6	8	10	12	16
2.5/10 A	2.5	3	4	5	6	8	10
1.5/6 A	1.5	2	2.5	3	4	5	6
1/4 A	1	1.25	1.5	2	2.5	3	4
0.8/3.2A	0.8	1	1.2	1.6	2	2.4	3.2
0.5/2 A	0.5	0.6	0.8	1.0	1.2	1.5	2
0.2/0.8A	0.2	0.25	0.3	0.4	0.5	0.6	0.8

Accuracy of pick-up current on all taps ±4%
(with the set current ICM2 and ICM22 just close their contact, the ICM21 just opens the contact)
Resetting current as percentage of pick-up current approx. 96%

Timing

Time curve for 100% setting of time dial
50 c/s Inverse time relay type ICM21 Fig. 8
50 c/s Inverse time relay type ICM2 Fig. 9
Very inverse time relay type ICM22 Fig. 11
60 c/s Inverse time relay type ICM2 Fig. 10
Very inverse time relay type ICM22 Fig. 12
Resetting time from 100% setting approx. 9.5 s
Contact follow time (after de-energizing) max. 0.02 s
Contact opening time (after de-energizing) max. 0.08 s
Current rating of contacts for closing
(contactor contact in parallel) 30 A at 250 V d.c.

Burden

At 50 c/s lowest selector setting 3.5 VA
highest selector setting 4.8 VA
At 60 c/s lowest selector setting 4.1 VA
highest selector setting 5.6 VA

Instantaneous Trip Element

Setting range type ICM2, ICM21
∞ and 2,5 to 10× current setting
type ICM22
∞ and 3 to 10× current setting
Accuracy ±10%
Closing time for currents more than 2× set value 0.03 s
Current rating for closing
(contactor contact in parallel) 30 A at 250 V d.c.

Auxiliary Contactor with Signal Button

Series coil with taps 0.2 and 1,2 A (for d.c. only)
0.2-A tap: (current range 0.2– 2 A) approx. 9.5 ohms
1,2-A tap: (current range 1,2–20 A) approx. 0.65 ohm
Voltage coil: rated voltages 24 to 250 V d.c. or a.c.
Contact rating: closing 30 A at 250 V d.c.

Net Weight

Single-pole relay in housing 8 lb
(3,65 kg)