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71 Applicant: **mitsubishi denki kabushiki
kaisha**
**2-3, Marunouchi 2-chome Chiyoda-ku
Tokyo(JP)**

72 Inventor: **Aoyama, Takahiro, c/o Itami
Seisakusho, Mitsubishi
Denki K.K., 1-1, Tsukaguchi, Hon Machi
8-chome
Amagasaki City, Hyogo Prefecture(JP)**

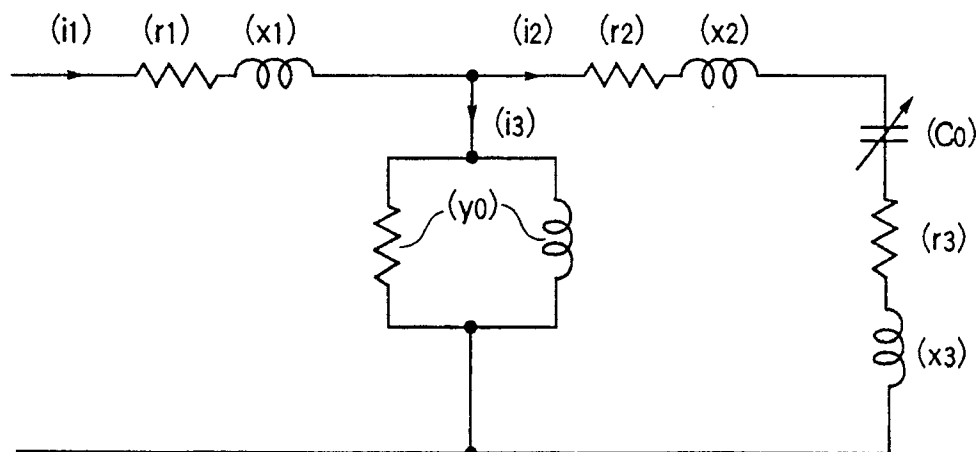
74 Representative: **Popp, Eugen, Dr. et al
MEISSNER, BOLTE & PARTNER
Widenmayerstrasse 48 Postfach 86 06 24
W-8000 München 86(DE)**

54 **Current transformer.**

57 A current transformer comprises a variable capacitor (C_0) connected in series with the burden ($r_3 + jx_3$) coupled across the secondary winding. The capacitance (C_0) of the capacitor is adjusted such that the capacitive reactance ($1/j\omega \cdot C_0$) cancels the combined inductive reactance ($j(x_2 + x_3)$) of the

secondary side leakage impedance ($r_2 + jx_2$) and of the externally connected burden ($r_3 + jx_3$). Thus the burden of the transformer is effectively reduced by an amount equal to the elimination of the reactance portion thereof. Hence the dimension of the core of the transformer can be reduced.

FIG. 2



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BACKGROUND OF THE INVENTION

This invention relates to current transformers, and more particularly to current transformers to which a burden is connected and which are installed in a power station or a substation for the measurement and protection purposes.

Generally, current transformers comprise a primary winding which forms part of the main circuit carrying the current to be measured, and a secondary winding which is magnetically coupled to the primary winding and across which a measurement instrument, etc., is coupled. Fig. 1 is an equivalent circuit diagram showing the organization of a conventional current transformer which is shown, for example, in K.Kamita, "Substation", The Newest Advanced Experiment Lectures, Vol. 13, 3rd ed., April 30, 1977, Denki Shoin. In Fig. 1, r_1 represents the resistance portion of the primary side leakage impedance; x_1 , the reactance portion of the primary side leakage impedance; r_2 , the resistance portion (converted to the primary side equivalent) of the secondary side leakage impedance; x_2 , the reactance portion (converted to the primary side equivalent) of the secondary side leakage impedance; r_3 , the resistance portion (converted to the primary side equivalent) of the externally connected burden; x_3 , the reactance portion (converted to the primary side equivalent) of the externally connected burden; y_0 , the exciting admittance; i_1 , the primary current; i_2 , the secondary current; and i_3 , the exciting current. Thus, the current transformer continuously supplies an apparent power equal to:

$$i_2 \times i_2 \times (r_2 + r_3 + j x_2 + j x_3),$$

wherein i_2 is proportional to the primary current i_1 .

The conventional transformer having an externally connected burden, however, has the following disadvantages. When the primary current i_1 and hence the secondary current i_2 proportional thereto is large, or when the secondary side leakage impedance, $r_2 + j x_2$, or the externally connected burden, $r_3 + j x_3$, is large, the dimension of the core of the transformer should be large enough to avoid the saturation thereof. Thus there arises the problem that the size of the transformer becomes large and the cost thereof becomes high.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide a current transformer which, without increasing the dimension of the transformer, is capable of coping with a large secondary current, or a large secondary side leakage impedance or a large externally connected burden.

The above object is accomplished in accordance with the principle of this invention by a current transformer wherein a capacitor is connected in series with the burden coupled across the secondary winding, the capacitance of the capacitor being adjusted to be serially resonated with the reactance portion of the secondary side impedance of the current transformer and the reactance portion of the burden. Thus, the burden to the transformer is effectively reduced.

dance with the principle of this invention by a current transformer wherein a capacitor is connected in series with the burden coupled across the secondary winding, the capacitance of the capacitor being adjusted to be serially resonated with the reactance portion of the secondary side impedance of the current transformer and the reactance portion of the burden. Thus, the burden to the transformer is effectively reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features which are believed to be characteristic of this invention are set forth with particularity in the appended claims. This invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood from the following detailed description of the preferred embodiment, taken in connection with the accompanying drawings, in which:

Fig. 1 is an equivalent circuit diagram of a conventional current transformer; and

Fig. 2 is an equivalent circuit diagram of a current transformer according to this invention.

In the drawings, like reference characters represent like or corresponding variables.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the following, an embodiment of this invention is described by reference to Fig. 2. The current transformer according to this invention comprises: a primary winding which forms part of the main circuit carrying the current to be measured; and secondary winding magnetically coupled to the primary winding; a burden coupled across the secondary winding; and a variable capacitor. Fig. 2 is a circuit diagram showing an equivalent circuit of the current transformer according to this invention, wherein the reference characters r_1 , x_1 , r_2 , x_2 , r_3 , x_3 , y_0 , i_1 , i_2 , and i_3 are as described above: namely, r_1 represents the resistance portion of the primary side leakage impedance; x_1 , the reactance portion of the primary side leakage impedance; r_2 , the resistance portion (converted to the primary side equivalent) of the secondary side leakage impedance; x_2 , the reactance portion (converted to the primary side equivalent) of the secondary side leakage impedance; r_3 , the resistance portion (converted to the primary side equivalent) of the externally connected burden; x_3 , the reactance portion (converted to the primary side equivalent) of the externally connected burden; y_0 , the exciting admittance; i_1 , the primary current; i_2 , the secondary current; and i_3 , the exciting current. Further, in the case of this embodiment, a variable capacitor

having an adjustable capacitance C_0 is connected in series with the externally connected burden, $r_3 + jx_3$, and hence with the secondary side leakage impedance, $r_2 + jx_2$. The capacitance C_0 of the capacitor is adjusted in such a manner that it is resonated serially with the reactance portion x_2 (converted to the primary side equivalent) of the secondary side leakage impedance and the reactance portion x_3 (converted to the primary side equivalent) of the externally connected burden. Namely, the capacitance C_0 is adjusted such that the capacitive reactance:

$$1/j\omega \cdot C_0$$

of the capacitor C_0 cancels the combined inductive reactance:

$$j(x_2 + x_3)$$

of the secondary side leakage impedance, $r_2 + jx_2$, of the transformer, and of the external burden, $r_3 + jx_3$. That is, the variable capacitance C_0 is adjusted such that the relation:

$$j/\omega \cdot C_0 = j(x_2 + x_3),$$

holds, wherein, ω is the angular frequency ($2\pi \times$ frequency). Thus, the capacitive reactance and the combined inductive reactance cancel each other, so that the overall reactance of the secondary side circuit substantially vanishes. Consequently, the core of the transformer can be reduced in size, and a small-sized and inexpensive current transformer is realized.

While description has been made of a particular embodiment of this invention, it will be understood that many modifications may be made without departing from the spirit thereof. The appended claims are contemplated to cover any such modifications as fall within the true spirit and scope of this invention.

Claims

1. A current transformer comprising:
 - a primary winding adapted to be coupled to a main circuit;
 - a secondary winding magnetically coupled to the primary winding;
 - a burden coupled across the secondary winding;
 - characterized by
 - a capacitor (C_0) connected in series with said burden ($r_3 + jx_3$), the capacitance of the capacitor (C_0) being adjusted to be serially reso-

nated with the reactance portion (x_2) of a secondary side impedance of the current transformer and the reactance portion (x_3) of the burden.

2. A current transformer as claimed in claim 1, wherein the capacitance of the capacitor (C_0) being adjusted such that the capacitive reactance ($1/j\omega \cdot C_0$) of the capacitance cancels the combined reactance of the secondary side impedance and the burden.
3. A current transformer as claimed in claim 1, wherein said capacitor (C_0) is a variable capacitor whose capacitance can be varied.

FIG. 1

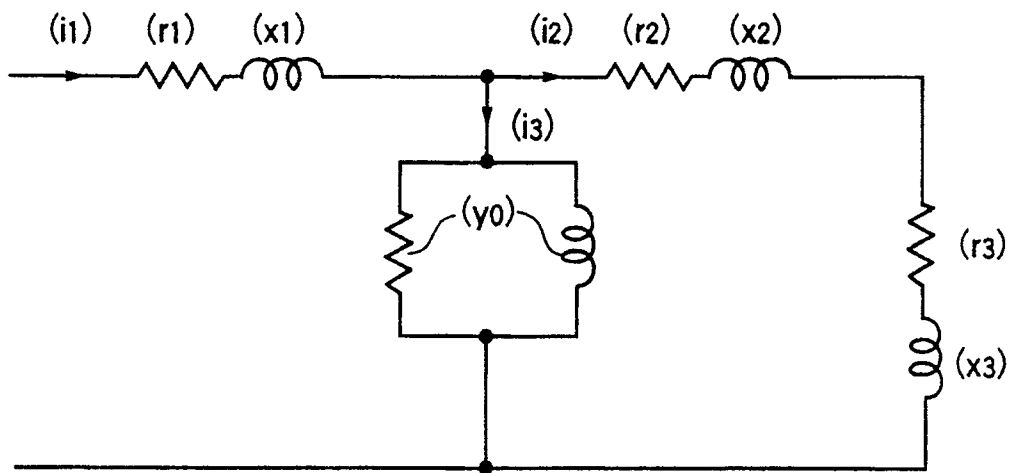
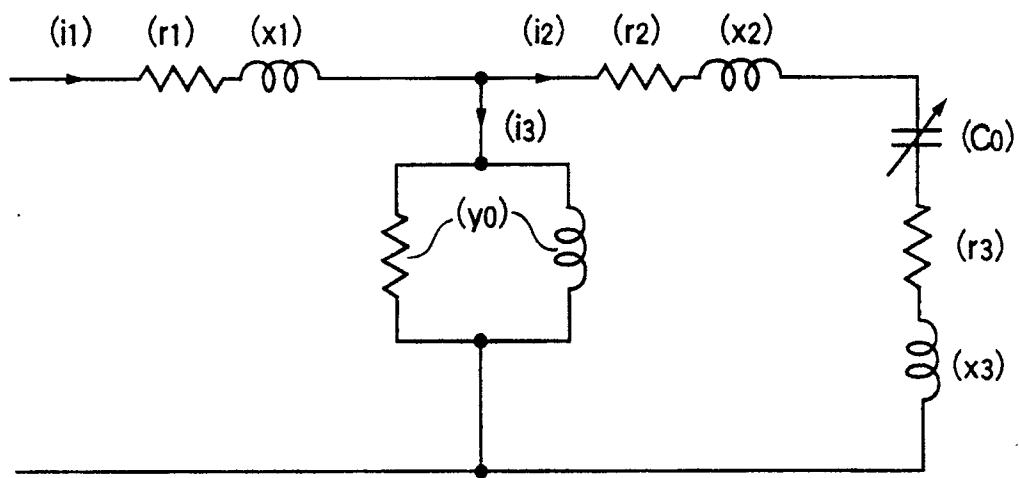


FIG. 2





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EUROPEAN SEARCH REPORT

Application Number

EP 90 12 2325

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	DE-C-7 521 54 (ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT, BERLIN-GRUNEWALD) * Page 2, right-hand column, lines 64-76; figure * - - -	1,2	H 01 F 40/14
A	CH-A-3 507 10 (AG BROWN, BOVERI & CIE, BADEN) * Page 1, lines 11-25; figure 1 * - - -	1,2	
A	DE-C-4 229 20 (SIEMENS & HALSKE AG IN BERLIN-SIEMENSSTADT) * Page 2, left-hand column, lines 14-19; figure 1 * - - - - -	1,3	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			H 01 F
The present search report has been drawn up for all claims			
Place of search		Date of completion of search	Examiner
The Hague		31 July 91	MARTI ALMEDA R.
CATEGORY OF CITED DOCUMENTS X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons ----- &: member of the same patent family, corresponding document			