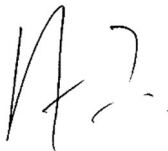


	Espacio reservado para el adhesivo de radicación
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DIRECCIÓN DE NUEVAS CREACIONES
Procedimiento acelerado de exámenes de patente (PPH)

1	NÚMERO DE SOLICITUD ANTE LA SIC NC2022/0004817		
2	GLOBAL - PPH ☒ PAÍS ESTADOS UNIDOS DE AMÉRICA	3	PCT – PPH ☐ PAÍS
4	PROSUR ☐ PAÍS	5	Alianza del Pacífico (AdP) ☐ PAÍS
6	OFICINA DE PRIMERA PRESENTACIÓN (OPP) ☐	7	OFICINA DE EXAMEN ANTERIOR (OEA) ☐
8	NÚMERO DE SOLICITUD O PUBLICACIÓN DE LA SOLICITUD (OPP) ☐ NÚMERO DE SOLICITUD EN OFICINA DE EXAMEN ANTERIOR (OEA): ☒ NÚMERO DE SOLICITUD PCT: ☐		1. US 17/109,015
9	☐ REPRESENTANTE LEGAL ☒ APODERADO		
APELLIDOS RINCÓN USCÁTEGUI		NOMBRES JOSÉ ANDRÉS	IDENTIFICACIÓN C.C. 79.780.910 T.P. 114.908
DIRECCIÓN	Carrera 4 # 72A - 35	No. TELÉFONO	3473611
CIUDAD	Bogotá, D.C.	CORREO ELECTRÓNICO	cavelier@cavelier.com
PAÍS	COLOMBIA	No. RADICACIÓN O PROTOCOLO DE PODER GENERAL	
10	CONDICIONES PARA ACCEDER A ESTE PROCESO:		
10.1. DATOS DE PRIORIDAD ☒ SI ☐ NO			
(33) PAÍS DE ORIGEN 1. ESTADOS UNIDOS DE AMÉRICA		CÓDIGO PAÍS US	(31) NÚMERO 62/944,296 (32) FECHA (AAAA/MM/DD) 2019/12/05
10.2. DATOS SOLICITUD INTERNACIONAL PCT ☐ SI ☐ NO			
Solicitud Internacional No. PCT/US2020/062726		Fecha 2020/12/01	
Publicación Internacional No. WO/2021/113252		Fecha 2021/06/10	
*El solicitante presenta una copia de la(s) reivindicación(es) patentable(s) u otorgable(s) de la solicitud de la Oficina de Primera Presentación que profirió el examen de patentabilidad, junto con una traducción al castellano. ☒ SI ☐ NO *El solicitante presenta los resultados de búsqueda de la Oficina de Examen Anterior, junto con una traducción al castellano ☐ SI ☐ NO			
REQUISITOS PARA EL RECONOCIMIENTO DE LOS RESULTADOS DE EXÁMENES DE PATENTABILIDAD EFECTUADOS A SOLICITUDES EXTRANJERAS Para que la Superintendencia de Industria y Comercio pueda reconocer los resultados de exámenes de patentabilidad producidos por otras Oficinas de Propiedad Industrial se debe cumplir con las siguientes condiciones: (a) Al momento de solicitar el examen de patentabilidad, si el solicitante pide que se reconozcan exámenes de patentabilidad de otras oficinas extranjeras, deberá aportar junto con el pago de la tasa correspondiente, los siguientes anexos: (i) Copia de las resoluciones, fallos o decisiones que han sido relevantes para la determinación de la patentabilidad de la(s) solicitud(es) en la Oficina que haya proferido el examen de patentabilidad que contienen reivindicaciones patentables u otorgables que son la base de la petición, y si es del caso, su traducción al castellano. ☒ SI ☐ NO (ii) Copia de todas las reivindicaciones determinadas como patentables u otorgables en la Oficina que profirió el examen de patentabilidad y, si es del caso, su traducción al castellano. ☒ SI ☐ NO (iii) Copia de los antecedentes, información o documentos citados por el examinador de la Oficina de Primera Presentación del examen de patentabilidad, en las resoluciones, fallos o decisiones correspondientes, incluyendo la literatura no patente. Los documentos de patente deberán presentarse siempre y cuando no estén disponibles para la Superintendencia de Industria y Comercio mediante el simple acceso a bases de datos gratuitas. ☐ SI ☒ NO (iv) Una tabla de correspondencias de las reivindicaciones que han sido determinadas como patentables u otorgables en la solicitud de la Oficina que haya proferido el examen de patentabilidad. ☒ SI ☐ NO			
11	FIRMA DEL SOLICITANTE, DEL APODERADO O DEL REPRESENTANTE LEGAL <i>Junto a cada firma, indicar el nombre del firmante y su calidad (si tal calidad no es obvia al leer el petitorio)</i>		
 ANDRÉS RINCÓN USCÁTEGUI C.C. No. 79.780.910 de Bogotá T.P.A. No. 114.908 del C.S.J.			

10 (iv)	TABLA DE CORRESPONDENCIA DE REIVINDICACIONES		
Reivindicaciones en la solicitud en Colombia		Reivindicaciones concedidas por la USPTO	Explicación sobre la suficiente correspondencia ó Comentarios que explican la correspondencia
1 - 20		1 – 20 respectivamente	<i>Las reivindicaciones 1 a 20 del capítulo reivindicatorio de la solicitud de patente NC2022/0004817 presentadas corresponden a las reivindicaciones 1 a 20, respectivamente, concedidas por la USPTO</i>

4. Copia de las reivindicaciones concedidas por la USPTO con su respectiva traducción al español;
5. Finalmente, a continuación, se encuentra la tabla donde se consigna la correspondencia de las reivindicaciones que han sido concedidas por la USPTO y las actualmente presentadas ante la SIC.

TABLA DE CORRESPONDENCIA

Reivindicaciones presentadas ante la SIC como OSP	Reivindicaciones consideradas patentables por la USPTO
1 a 20	1 a 20, respectivamente

Se considera entonces, que las reivindicaciones presentadas son “suficientemente correspondientes” a las concedidas por la USPTO, ya que las reivindicaciones presentadas ante la SIC se refieren a la misma materia que aquella consideradas como otorgables por la Oficina de Examen Anterior (OEA).

Cumpliendo así lo dispuesto para que una solicitud sea aceptada en el procedimiento acelerado de exámenes de patente entre la USPTO actuando como Oficina de Examen Anterior (OEA) y la SIC como Oficina de Segunda Presentación, atentamente solicito que se continúe con el trámite correspondiente a esta solicitud de patente de invención.

Señora Directora,

ANDRÉS RINCÓN USCÁTEGUI

CC 79.780.910 de Bogotá

TP 114.908



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

24275 7590 03/31/2022
S & C Electric Company
Anthony G. Sitko
6601 N. Ridge Blvd.
Chicago, IL 60626-3904

EXAMINER	
CURTIS, SEAN M	
ART UNIT	PAPER NUMBER
2858	

DATE MAILED: 03/31/2022

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/109,015	12/01/2020	David G. Porter	SC-5624	1074

TITLE OF INVENTION: LOW ENERGY RECLOSING PULSE TEST

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1200	\$0.00	\$0.00	\$1200	06/30/2022

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

24275 7590 03/31/2022
S & C Electric Company
Anthony G. Sitko
6601 N. Ridge Blvd.
Chicago, IL 60626-3904

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

	(Typed or printed name)
	(Signature)
	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/109,015	12/01/2020	David G. Porter	SC-5624	1074

TITLE OF INVENTION: LOW ENERGY RECLOSING PULSE TEST

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1200	\$0.00	\$0.00	\$1200	06/30/2022

EXAMINER	ART UNIT	CLASS-SUBCLASS
CURTIS, SEAN M	2858	324-424000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

1 _____

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☐ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

4b. Method of Payment: (Please first reapply any previously paid fee shown above)

☐ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. Change in Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/109,015	12/01/2020	David G. Porter	SC-5624	1074
24275	7590	03/31/2022	EXAMINER	
S & C Electric Company Anthony G. Sitko 6601 N. Ridge Blvd. Chicago, IL 60626-3904			CURTIS, SEAN M	
			ART UNIT	PAPER NUMBER
			2858	
DATE MAILED: 03/31/2022				

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 17/109,015	Applicant(s) Porter et al.	
	Examiner SEAN CURTIS	Art Unit 2858	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 1 December 2020 and 9 March 2022.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are 1-20. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a) ☐ All b) ☐ Some* c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. _____.

3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892) 2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date <u>9 March 2022</u> . 3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____. 4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.	5. ☐ Examiner's Amendment/Comment 6. ☒ Examiner's Statement of Reasons for Allowance 7. ☐ Other _____.
---	--

/SEAN CURTIS/ Examiner, Art Unit 2858	/Patrick Assouad/ Supervisory Patent Examiner, Art Unit 2858
--	---

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Information Disclosure Statement

2. The information disclosure statement (IDS) submitted on 3/9/2022 is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Claim Interpretation

3. The following is a quotation of 35 U.S.C. 112(f):

(f) Element in Claim for a Combination. – An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

The following is a quotation of pre-AIA 35 U.S.C. 112, sixth paragraph:

An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

4. The claims in this application are given their broadest reasonable interpretation using the plain meaning of the claim language in light of the specification as it would be understood by one of ordinary skill in the art. The broadest reasonable interpretation of a claim element (also commonly referred to as a claim limitation) is limited by the description in the specification when 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, is invoked.

As explained in MPEP § 2181, subsection I, claim limitations that meet the following three-prong test will be interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph:

- (A) the claim limitation uses the term “means” or “step” or a term used as a substitute for “means” that is a generic placeholder (also called a nonce term or a non-structural term having no specific structural meaning) for performing the claimed function;
- (B) the term “means” or “step” or the generic placeholder is modified by functional language, typically, but not always linked by the transition word “for” (e.g., “means for”) or another linking word or phrase, such as “configured to” or “so that”; and
- (C) the term “means” or “step” or the generic placeholder is not modified by sufficient structure, material, or acts for performing the claimed function.

Use of the word “means” (or “step”) in a claim with functional language creates a rebuttable presumption that the claim limitation is to be treated in accordance with 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph. The presumption that the claim limitation is interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, is rebutted when the claim limitation recites sufficient structure, material, or acts to entirely perform the recited function.

Absence of the word “means” (or “step”) in a claim creates a rebuttable presumption that the claim limitation is not to be treated in accordance with 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph. The presumption that the claim limitation is not interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, is rebutted when the claim limitation

Art Unit: 2858

recites function without reciting sufficient structure, material or acts to entirely perform the recited function.

Claim limitations in this application that use the word “means” (or “step”) are being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, except as otherwise indicated in an Office action. Conversely, claim limitations in this application that do not use the word “means” (or “step”) are not being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, except as otherwise indicated in an Office action.

5. This application includes one or more claim limitations that use the word “means” or “step” but are nonetheless not being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph because the claim limitation(s) recite(s) sufficient structure, materials, or acts to entirely perform the recited function. Such claim limitation(s) is/are: the system comprising: means for energizing a magnetic actuator and means for de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator in claim 17.

Because this/these claim limitation(s) is/are **not** being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, it/they is/are **not** being interpreted to cover only the corresponding structure, material, or acts described in the specification as performing the claimed function, and equivalents thereof.

If applicant intends to have this/these limitation(s) interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, applicant may: (1) amend the claim limitation(s) to remove the structure, materials, or acts that performs the claimed function; or (2) present a sufficient showing that the claim limitation(s) does/do not recite sufficient structure, materials, or acts to perform the claimed function.

Allowable Subject Matter

6. Claims 1-20 are allowed.

7. The following is an examiner's statement of reasons for allowance:

8. Regarding Claim 1, the references cited on PTO-892 form, alone or in combination form, fail to disclose a method for operating a magnetically actuated switch assembly to perform a low energy test pulse, the switch assembly including a fixed contact and a movable contact, the method comprising:

energizing a magnetic actuator to move the actuator against the bias of at least one spring coupled to the movable contact towards the fixed contact to make contact therebetween, wherein AC current conducts across a gap between the movable contact and the fixed contact before the movable contact and the fixed contact make contact; and

de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator when the movable contact makes contact with the fixed contact so as to allow the bias of the at least one spring to move the movable contact away from the fixed contact so that the amount of time that the current conducts between the movable contact and the fixed contact is about one fundamental frequency cycle of the current, wherein energizing the magnetic actuator occurs at a time so that when the movable contact and the fixed contact begin conducting an applied voltage on the switch assembly is at or near a peak of the voltage wave so that the current is symmetric (highlighted for emphasis).

9. Claims 2-9 depend upon that of Claim 1 and require all of the limitations of Claim 1, therefore Claims 2-9 are too considered as allowed.

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10. Regarding Claim 10, the references cited on PTO-892 form, alone or in combination form, fail to disclose a method for performing a reclosing fault testing operation in a power distribution network using a vacuum interrupter including a fixed contact and a movable contact, the method comprising:

energizing a magnetic actuator to move the actuator against the bias of at least one spring coupled to the movable contact towards the fixed contact to make contact therebetween, wherein AC fault current conducts across a gap between the movable contact and the fixed contact before the movable contact and the fixed contact make contact; and

de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator when the movable contact makes contact with the fixed contact so as to allow the bias of the at least one spring to move the movable contact away from the fixed contact so that the amount of time that the current conducts between the movable contact and the fixed contact is about one fundamental frequency cycle of the fault current (highlighted for emphasis).

11. Claims 11-13 depend upon that of Claim 10 and require all of the limitations of Claim 10, therefore Claims 11-13 are too considered as allowed.

12. Regarding Claim 14, the references cited on PTO-892 form, alone or in combination form, fail to disclose a method for performing a low energy pulse testing operation in a power distribution network using a vacuum interrupter including a fixed contact and a movable contact, the method comprising:

energizing a magnetic actuator to move the actuator against the bias of at least one spring coupled to the movable contact towards the fixed contact to make contact

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therebetween, wherein AC fault current conducts across a gap between the movable contact and the fixed contact before the movable contact and the fixed contact make contact; and

de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator so as to allow the bias of the at least one spring to move the movable contact away from the fixed contact, wherein energizing the magnetic actuator occurs at a time so that when the movable contact and the fixed contact begin conducting an applied voltage on the switch assembly is at or near a peak of the voltage wave so that the fault current is symmetric (highlighted for emphasis).

13. Claims 15-16 depend upon that of Claim 14 and require all of the limitations of Claim 14, therefore Claims 15-16 are too considered as allowed.

14. Regarding Claim 17, the references cited on PTO-892 form, alone or in combination form, fail to disclose a system for using a magnetically actuated switch assembly to produce a low energy pulse test, the switch assembly including a fixed contact and a movable contact, the system comprising:

means for energizing a magnetic actuator to move the actuator against the bias of at least one spring coupled to the movable contact towards the fixed contact to make contact therebetween, wherein AC current conducts across a gap between the movable contact and the fixed contact before the movable contact and the fixed contact make contact; and

means for de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator when the movable contact makes contact with the fixed contact so as to allow the bias of the at least one spring to move the movable contact away from the fixed contact so that the amount of time that the current conducts between the movable contact and the fixed contact

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is about one fundamental frequency cycle of the current, wherein energizing the magnetic actuator occurs at a time so that when the movable contact and the fixed contact begin conducting an applied voltage on the switch assembly is at or near a peak of the voltage wave so that the current is symmetric (highlighted for emphasis).

15. Claims 18-20 depend upon that of Claim 17 and require all of the limitations of Claim 17, therefore Claims 18-20 are too considered as allowed.

16. **Examiner's Note:** *The references cited on the PTO-892 form disclose systems and methods for operating magnetically actuated switch assemblies such as breakers, reclosers, interrupters, etc. that control the flow of power throughout a power distribution network to perform low energy pulse testing, wherein the magnetically actuated switch assemblies include fixed/stationary and movable contacts that are energized to move the actuated switching device against the bias of at least one spring coupled to the movable contact towards the fixed contact to make contact therebetween and de-energizing or reversing the voltage on the magnetically actuated switching device so as to allow the bias of the at least one spring to move the movable contact away from the fixed contact.*

17. *However, the references cited fail to disclose wherein during the energizing process an AC current conducts across a gap between the movable contact and the fixed contact before the movable contact and the fixed contact make contact or wherein during the de-energizing process the amount of time that the current conducts between the movable contact and the fixed contact is about one fundamental frequency cycle of the current, and that energizing the magnetic actuator occurs at a time so that when the movable contact and the fixed contact*

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begin conducting an applied voltage on the switch assembly is at or near a peak of the voltage wave so that the current is symmetric.

18. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

19. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The references cited on PTO-892 form are related to the art of the present invention with respect to systems and methods for performing a low energy pulse testing operation in a power distribution network to determine if a fault condition is present.

20. Any inquiry concerning this communication or earlier communications from the examiner should be directed to SEAN CURTIS whose telephone number is (571)272-3564. The examiner can normally be reached M-F 8am-5pm; Alternate Fridays off.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Assouad can be reached on 5712722210. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2858

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit:

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Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO

Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

SEAN CURTIS

Examiner

Art Unit 2858

/SEAN CURTIS/

Examiner, Art Unit 2858

/Patrick Assouad/

Supervisory Patent Examiner, Art Unit 2858

<i>Notice of References Cited</i>	Application/Control No. 17/109,015		Applicant(s)/Patent Under Reexamination Porter et al.	
	Examiner SEAN CURTIS		Art Unit 2858	Page 1 of 3

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20190252139-A1	08-2019	Falkingham; Leslie	H01H33/12	1/1
*	B	US-20150332880-A1	11-2015	Falkingham; Leslie Thomas	H01H9/20	218/142
*	C	US-20080266733-A1	10-2008	O'Leary; Raymond P.	H01H75/04	361/71
*	D	US-20190304721-A1	10-2019	Falkingham; Leslie Thomas	H01H9/20	1/1
*	E	US-10600593-B2	03-2020	Falkingham; Leslie Thomas	H01H33/6662	1/1
*	F	US-6580947-B1	06-2003	Thompson; David L.	A61N1/37211	607/30
*	G	US-5452172-A	09-1995	Lane; Stephen E.	H02H1/06	361/72
*	H	US-20200411261-A1	12-2020	Zhou; Xin	H01H33/285	1/1
*	I	US-20200244059-A1	07-2020	LELLIS JUNIOR; Celso Garcia	H01H47/226	1/1
*	J	US-7432788-B2	10-2008	Glukh; Konstantin	H01H36/00	335/78
*	K	US-20040263297-A1	12-2004	Glukh, Konstantin	H01H1/0036	335/207
*	L	US-6911610-B2	06-2005	Gemme; Carlo	H02H1/06	335/229
*	M	US-20200251294-A1	08-2020	Rusev; Tsvetan	H01H33/6662	1/1

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	N	WO-2015114375-A1	08-2015	WO	FALKINGHAM L T	H01H33/38
	O	WO-2021047795-A1	03-2021	WO	CHEN S	H01H33/6662
	P	EP-3675147-A1	07-2020	EP	DE OLIVEIRA A A P	G01R15/181
	Q	CN-102084568-A	06-2011	CN	MONTENEGRO A	H01H75/04
	R	KR-100809902-B1	03-2008	KR	Name not available	H02B13/0354
	S	KR-20070120628-A	12-2007	KR	SIK KIM EUI	H01H33/38
	T	KR-100668923-B1	01-2007	KR	KYO JUNG HYUN	H01H3/28

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	PCT/US2020/062726 International Search Report and Written Opinon. February 2021. (Year: 2021)
	V	
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

<i>Notice of References Cited</i>	Application/Control No. 17/109,015		Applicant(s)/Patent Under Reexamination Porter et al.	
	Examiner SEAN CURTIS		Art Unit 2858	Page 2 of 3

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20210175033-A1	06-2021	Porter; David G.	G01R31/3271	1/1
*	B	US-20220020546-A1	01-2022	Delbaere; Stéphane	H01H47/002	1/1
*	C	US-20220076912-A1	03-2022	MITTELSTADT; Chad R.	H01H50/18	1/1
*	D	US-20220082594-A1	03-2022	Clarke; Roger	G01R19/16523	1/1
	E					
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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N	WO-2006069957-A1	07-2006	WO	ADUNKA R	H01H1/0015
	O	WO-2006069970-A1	07-2006	WO	HARTINGER P	H01H1/0015
	P	WO-2005006365-A1	01-2005	WO	AGRAWAL V	H01H1/0036
	Q	EP-1639612-B1	02-2007	EP	AGRAWAL V	H01H1/0036
	R	CA-2395661-A1	07-2001	CA	DAVIES N	H02B13/0354
	S	KR-20010030619-A	04-2001	KR	Name not available	H01H33/6662
	T	WO-0109912-A2	02-2001	WO	DOSMO R	H01H33/6662

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<i>Notice of References Cited</i>	Application/Control No. 17/109,015	Applicant(s)/Patent Under Reexamination Porter et al.	
	Examiner SEAN CURTIS	Art Unit 2858	Page 3 of 3

U.S. PATENT DOCUMENTS

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	A					
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	J					
	K					
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	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
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	O	WO-2020131908-A1	06-2020	WO	DJOGO G	G01R31/086
	P	WO-2021113252-A1	06-2021	WO	ABRAMCZYK L	G01R31/3278
	Q	WO-2020093132-A1	05-2020	WO	COUTURE P	H01F7/13
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	S					
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Doc code: IDS

PTO/SB/08a (02-18)

Doc description: Information Disclosure Statement (IDS) Filed

Approved for use through 11/30/2020. OMB 0651-0031

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	17109015
	Filing Date	2020-12-01
	First Named Inventor	David G. Porter
	Art Unit	2837 2858
	Examiner Name	~~Alexander Taipalatski~~ S. Curtis
	Attorney Docket Number	SC-5624

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	1	20080266733	A1	2008-10-30	O'Leary et al.	
	2	20150332880	A1	2015-11-19	Falkingham	
	3	20190252139	A1	2019-08-15	Falkingham	

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**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number		17109015
Filing Date		2020-12-01
First Named Inventor	David G. Porter	
Art Unit	2837	2858
Examiner Name	~~Alexander Talpalatski~~ S. Curtis	
Attorney Docket Number	SC-5624	

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NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1	International Search Report and Written Opinion for International Application Number PCT/US2020/062726 dated February 19, 2020. (10 pages)	

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EXAMINER SIGNATURE

Examiner Signature	/SEAN CURTIS/	Date Considered	03/26/2022
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	17109015
Filing Date	2020-12-01
First Named Inventor	David G. Porter
Art Unit	2837
Examiner Name	Alexander Talpalatski
Attorney Docket Number	SC-5624

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Anthony G. Sitko, 36278/	Date (YYYY-MM-DD)	2022-03-09
Name/Print	Anthony G Sitko	Registration Number	36278

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ACCIÓN DETALLADA

[...]

Interpretación de las reivindicaciones

3. A continuación se cita el artículo 35 U.S.C. 112 (f):

(f) Elemento en la reivindicación de una combinación. – Un elemento en una reivindicación de una combinación puede expresarse como un medio o un paso para realizar una función especificada sin la recitación de la estructura, el material o los actos en apoyo de la misma, y se interpretará que dicha reivindicación abarca la estructura, el material o los actos correspondientes descritos en la descripción y sus equivalentes.

A continuación, se cita el párrafo sexto del 35 U.S.C 112 anterior a la Ley de Propiedad Intelectual

Un elemento en una reivindicación de una combinación puede expresarse como un medio o un paso para realizar una función especificada sin la recitación de la estructura, el material o los actos en apoyo de la misma, y se interpretará que dicha reivindicación abarca la estructura, el material o los actos correspondientes descritos en la descripción y sus equivalentes.

Las reivindicaciones de la presente solicitud se interpretan de la forma más amplia posible, utilizando el sentido llano del lenguaje de la reivindicación a la luz de la descripción tal y como lo entendería una persona con conocimientos ordinarios de la técnica. La interpretación más amplia y razonable de un elemento de la reivindicación (también denominada comúnmente limitación de la reivindicación) está limitada por la descripción cuando se invoca el 35 U.S.C. 112(f) o el 35 U.S.C. 112, sexto párrafo.

Como se explica en el MPEP 2181, subsección I, las limitaciones de las reivindicaciones que cumplan la siguiente prueba de tres puntas se interpretarán con arreglo al 35 U.S.C. 112(f) o el pre AIA 35 U.S.C. 112, sexto párrafo:

(A) la limitación de la reivindicación utiliza el término “medio” o “paso” o un término utilizado como sustituto de “medio” que es un marcador de posición genérico (también llamado término no estructural o un término no estructural que no tiene un significado estructural específico) para realizar la función reivindicada;

(B) el término “medio” o “paso” o el marcador de posición genérico es modificado por el lenguaje funcional, típicamente, pero no siempre vinculado por la palabra de transición “para” (por ejemplo, “medio para”) u otra palabra o frase de enlace, como “configurado para” o “para que”; y

(C) el término “medio” o “paso” o el marcador de posición genérico no está modificado por una estructura, material o actos suficientes para realizar la función reivindicada.

La ausencia de la palabra “medio” (o “paso”) en una reivindicación crea una presunción refutable de que la limitación de la reivindicación no debe ser tratada de acuerdo con el 35 U.S.C. 112(f) o el pre-AIA 35 U.S.C. 112, sexto párrafo. La presunción de que la limitación de la reivindicación se interpreta de acuerdo con el 35 U.S.C. 112(f) o el pre-AIA 35 U.S.C. 112, sexto párrafo, se refuta cuando la limitación de la reivindicación recita suficiente estructura, material o actos para realizar completamente la función recitada.

Las limitaciones de las reivindicaciones de esta solicitud que utilizan la palabra “medio” (o “paso”) se interpretan según el 35 U.S.C. 112(f) o el pre-AIA 35 U.S.C. 112, sexto párrafo, salvo que se indique lo contrario en una Acción Oficial. En cambio, las limitaciones de las reivindicaciones de esta solicitud que no utilizan la palabra “medio” (o “paso”) no se interpretan en virtud de 35 U.S.C. 112(f) o el pre-AIA 35 U.S.C. 112, sexto párrafo, salvo que se indique lo contrario en una acción oficial.

5. Esta solicitud incluye una o más limitaciones de la reivindicación que utilizan la palabra “medio” o “paso” pero que, sin embargo, no están siendo interpretadas bajo 35 U.S.C. 112(f) o pre-AIA 35 U.S.C. 112, sexto párrafo, porque la(s) limitación(es) de la reivindicación limita(n) suficiente(s) estructura(s), materiales o actos para realizar completamente la función recitada. Dicha(s) limitación(es) de la reivindicación es/son: el sistema que comprende medios para energizar un actuador magnético para mover el actuador y medios para desenergizar el actuador magnético o invertir el voltaje en el actuador magnético en la reivindicación 17.

Debido a que esta(s) limitación(es) de la reivindicación no está(n) siendo interpretada(s) bajo 35 U.S.C. 112(f) o pre-AIA 35 U.S.C. 112, sexto párrafo, se interpreta que sólo cubre la estructura, el material o los actos correspondientes descritos en la especificación como realizadores de la función reivindicada y sus equivalentes.

Si el solicitante pretende que esta(s) limitación(es) sea(n) interpretada(s) en virtud de 35 U.S.C. 112(f) o pre-AIA 35 U.S.C. 112, sexto párrafo, el solicitante puede (1) modificar la(s) limitación(es) de la reivindicación para eliminar la estructura, los materiales o los actos que realizan la función reivindicada; o (2) presentar una demostración suficiente de que la(s) limitación(es) de la reivindicación no recita(n) suficiente estructura, materiales o actos para realizar la función reivindicada.

Materia permitida

6. Se admiten las reivindicaciones 1-20.

7. A continuación, el examinador expone los motivos de la concesión:

8. En cuanto a la reivindicación 1, las referencias citadas en la forma PTO-892, solas o en forma combinada, no divulgan un método para operar un conjunto del interruptor accionado magnéticamente para realizar un pulso de prueba de baja energía, el conjunto del interruptor incluye un contacto fijo y un contacto móvil, el método que comprende:

energizar un actuador magnético para mover el actuador contra la polarización de al menos un resorte acoplado al contacto móvil hacia el contacto fijo para hacer contacto entre

ellos, en donde la corriente de CA se conduce a través de un espacio entre el contacto móvil y el contacto fijo antes de que el contacto móvil y el contacto fijo hagan contacto; y

desenergizar el actuador magnético o invertir el voltaje en el actuador magnético cuando el contacto móvil hace contacto con el contacto fijo para permitir que la polarización del al menos un resorte aleje el contacto móvil del contacto fijo para que la cantidad de tiempo que la corriente conduce entre el contacto móvil y el contacto fijo sea aproximadamente un ciclo de frecuencia fundamental de la corriente, en donde la energización del actuador magnético ocurre en un momento en que cuando el contacto móvil y el contacto fijo comienzan a conducir un voltaje aplicado en el conjunto del interruptor está en o cerca de un pico de la onda del voltaje para que la corriente sea simétrica (resaltado para énfasis).

9. Reivindicaciones 2-9 dependen de la reivindicación 1 y requieren todas las limitaciones de la reivindicación 1, por consiguiente, las reivindicaciones 2-9 también se consideran permitidas.

10. En cuanto a la reivindicación 10, las referencias citadas en la forma PTO-892, solas o combinadas no divulgan un método para realizar una operación de prueba de falla de reconexión en una red de distribución de energía utilizando un interruptor de vacío que incluye un contacto fijo y un contacto móvil, el método que comprende:

energizar un actuador magnético para mover el actuador contra la polarización de al menos un resorte acoplado al contacto móvil hacia el contacto fijo para hacer contacto entre ellos, en donde la corriente de falla de CA se conduce a través de un espacio entre el contacto móvil y el contacto fijo antes del contacto móvil y el contacto fijo hagan contacto; y

desenergizar el actuador magnético o invertir el voltaje en el actuador magnético cuando el contacto móvil hace contacto con el contacto fijo para permitir que la polarización del al menos un resorte aleje el contacto móvil del contacto fijo para que la cantidad de tiempo que la corriente conduce entre el contacto móvil y el contacto fijo sea aproximadamente un ciclo de frecuencia fundamental de la corriente de falla (resaltado para énfasis).

11. Las reivindicaciones 11-13 dependen de la reivindicación 10 y requieren todas las limitaciones de la reivindicación 10, por consiguiente, las reivindicaciones 11-13 también se consideran permitidas.

12. En cuanto a la reivindicación 14, las referencias citadas en la forma PTO-892, solas o combinadas no divulgan un método para realizar una operación de prueba del pulso de baja energía en una red de distribución de energía utilizando un interruptor de vacío que incluye un contacto fijo y un contacto móvil, el método que comprende:

energizar un actuador magnético para mover el actuador contra la polarización de al menos un resorte acoplado al contacto móvil hacia el contacto fijo para hacer contacto entre ellos, en donde la corriente de falla de CA se conduce a través de un espacio entre el contacto móvil y el contacto fijo antes del contacto móvil y el contacto fijo hagan contacto; y

desenergizar el actuador magnético o invertir el voltaje en el actuador magnético para permitir que la polarización del al menos un resorte aleje el contacto móvil del contacto fijo, en donde la energización del actuador magnético ocurre en un momento en que cuando el contacto

móvil y el contacto fijo comienzan a conducir un voltaje aplicado en el conjunto del interruptor está en o cerca del pico de la onda del voltaje para que la corriente de falla sea simétrica (resaltado para énfasis).

13. Las reivindicaciones 15-16 dependen de la reivindicación 14 y requieren todas las limitaciones de la reivindicación 14, por consiguiente, las reivindicaciones 15-16 también se consideran permitidas.

14. En cuanto a la reivindicación 17, las referencias citadas en la forma PTO-892, solas o combinadas no divulgan Un sistema para usar un conjunto del interruptor accionado magnéticamente para producir una prueba de pulso de baja energía, el conjunto del interruptor incluye un contacto fijo y un contacto móvil, el sistema que comprende:

medios para energizar un actuador magnético para mover el actuador contra la polarización de al menos un resorte acoplado al contacto móvil hacia el contacto fijo para hacer contacto entre ellos, en donde la corriente de CA se conduce a través de un espacio entre el contacto móvil y el contacto fijo antes de que el contacto móvil y el contacto fijo hagan contacto; y

medios para desenergizar el actuador magnético o invertir el voltaje en el actuador magnético cuando el contacto móvil hace contacto con el contacto fijo para permitir que la polarización del al menos un resorte aleje el contacto móvil del contacto fijo para que la cantidad de tiempo que la corriente conduce entre el contacto móvil y el contacto fijo es aproximadamente un ciclo de frecuencia fundamental de la corriente, en donde la energización del actuador magnético ocurre en un momento en que cuando el contacto móvil y el contacto fijo comienzan a conducir un voltaje aplicado en el conjunto del interruptor está en o cerca de un pico de la onda del voltaje para que la corriente sea simétrica (resaltado para énfasis).

15. Las reivindicaciones 18-20 dependen de la reivindicación 17 y requieren todas las limitaciones de la reivindicación 17, por consiguiente, las reivindicaciones 18-20 también se consideran permitidas.

16. ***Nota del examinador:*** Las referencias citadas en el formulario PTO-892 revelan sistemas y métodos para operar conjuntos de interruptores accionados magnéticamente, como disyuntores, reconectores, interruptores, etc. que controlan el flujo de energía a través de una red de distribución de energía para realizar pruebas de impulsos de baja energía, en las que los conjuntos de conmutadores accionados magnéticamente incluyen contactos fijos/estacionarios y móviles que se energizan para mover el dispositivo de conmutación accionado contra el sesgo de al menos un resorte acoplado al contacto móvil hacia el contacto fijo para hacer contacto entre ellos y desenergizar o invertir la tensión en el dispositivo de conmutación accionado magnéticamente para permitir que el sesgo del al menos un muelle aleje el contacto móvil del contacto fijo.

17. Sin embargo, las referencias citadas no revelan que durante el proceso de energización una corriente alterna conduce a través de un espacio entre el contacto móvil y el contacto fijo antes de que el contacto móvil y el contacto fijo hagan contacto o que durante el proceso de desenergización la cantidad de tiempo que la corriente conduce entre el contacto móvil y el contacto fijo es aproximadamente un ciclo de frecuencia fundamental de la corriente, en donde la energización del actuador magnético ocurre en un momento en que cuando el contacto móvil y el contacto fijo

Número de solicitud/Control: 17/109, 015

Unidad de arte: 2858

comienzan a conducir un voltaje aplicado en el conjunto del interruptor está en o cerca de un pico de la onda del voltaje para que la corriente sea simétrica.



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Porter et al.

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(45) **Date of Patent:** **May 10, 2022**

(54) **LOW ENERGY RECLOSING PULSE TEST**

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(73) Assignee: **S&C Electric Company**, Chicago, IL (US)

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 58 days.

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Assistant Examiner — Sean Curtis

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H01H 33/666 (2006.01)
H01H 36/00 (2006.01)
G01R 31/327 (2006.01)

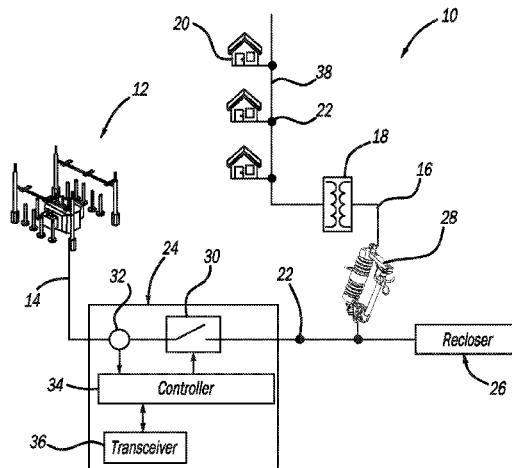
(52) **U.S. Cl.**
CPC **H01H 33/6662** (2013.01); **G01R 31/3271** (2013.01); **G01R 31/3278** (2013.01); **H01H 36/00** (2013.01)

(58) **Field of Classification Search**
CPC G01R 31/3271; G01R 31/3278; G01R 31/3272; G01R 31/327; G01R 31/333;
(Continued)

(57) **ABSTRACT**

A method for performing a low energy pulse testing in a power distribution network that causes contacts to close and then open in about one fundamental frequency cycle of current flow time and close on a voltage waveform that produces symmetrical fault current. The method includes energizing a magnetic actuator to move the actuator against the bias of a spring to move a movable contact towards a fixed contact. The method also includes de-energizing the actuator when the movable contact makes contact with the fixed contact so as to allow the spring to move the movable contact away from the fixed contact so that the amount of time that the current conducts is about one fundamental frequency cycle of the current, where energizing the magnetic actuator occurs when an applied voltage on the switch assembly is at a peak of the voltage wave so that the current is symmetric.

20 Claims, 3 Drawing Sheets



(58) **Field of Classification Search**

CPC G01R 31/3333; H01H 33/6662; H01H
36/00; H01H 81/00; H02H 3/06; H02H
3/066; H02H 7/008

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See application file for complete search history.

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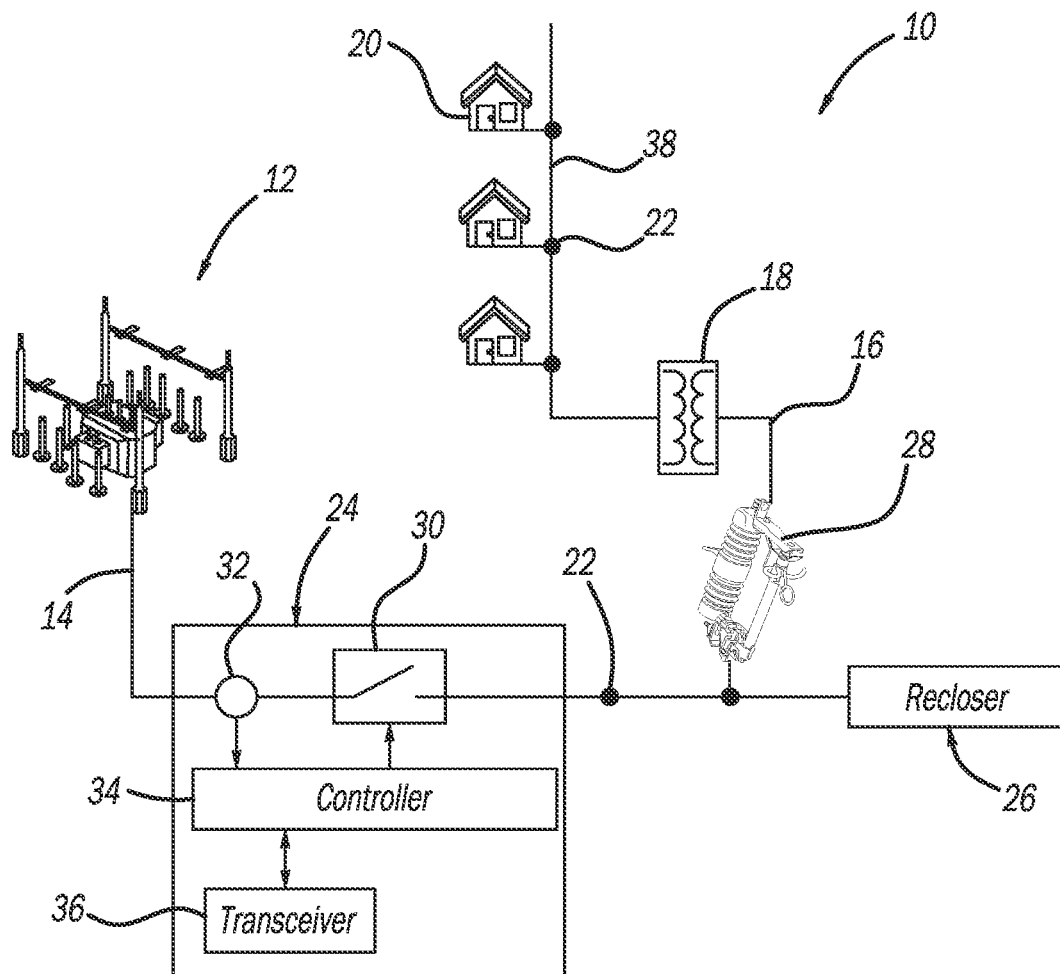
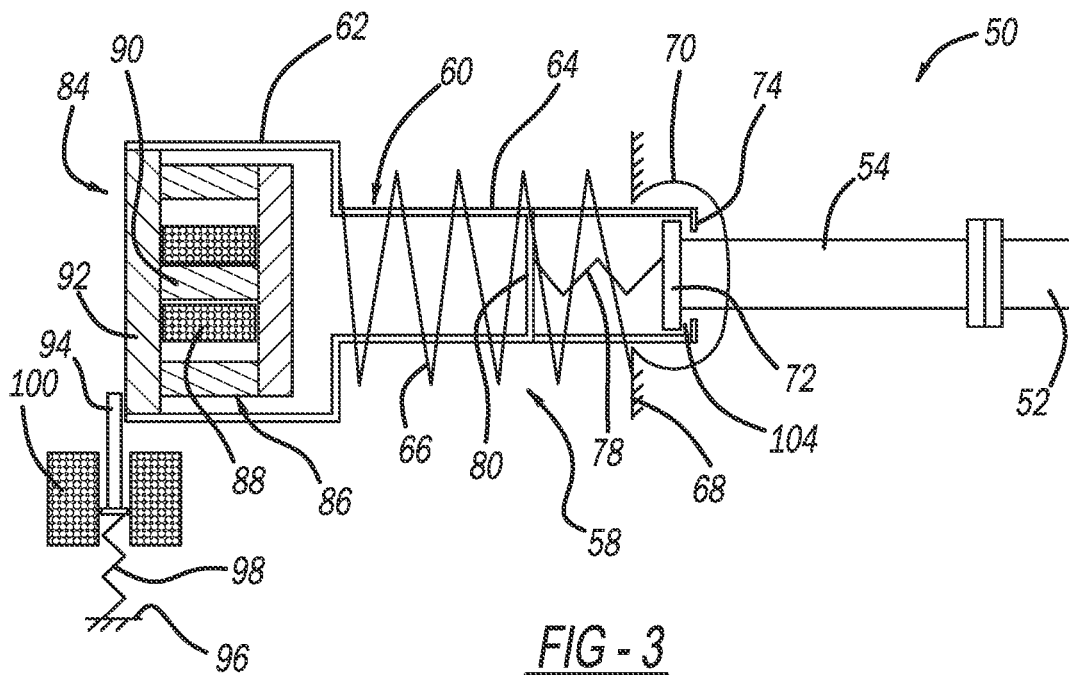
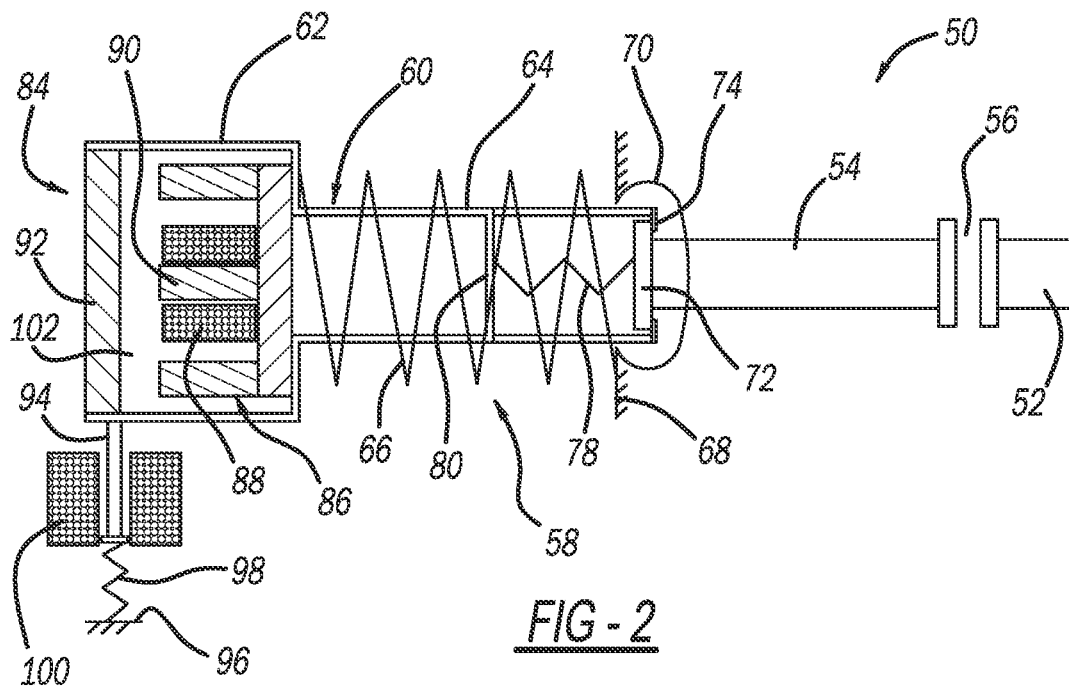


FIG - 1



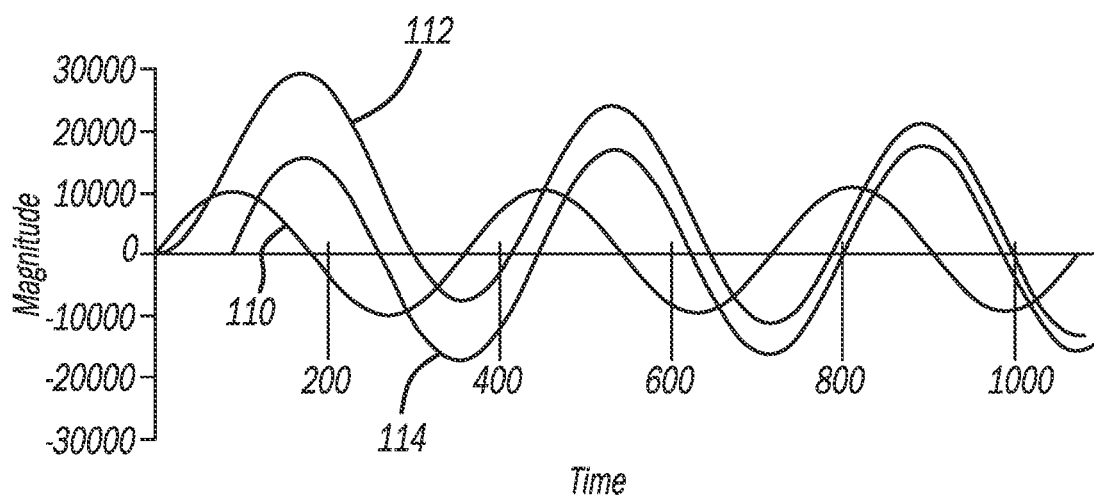


FIG - 4

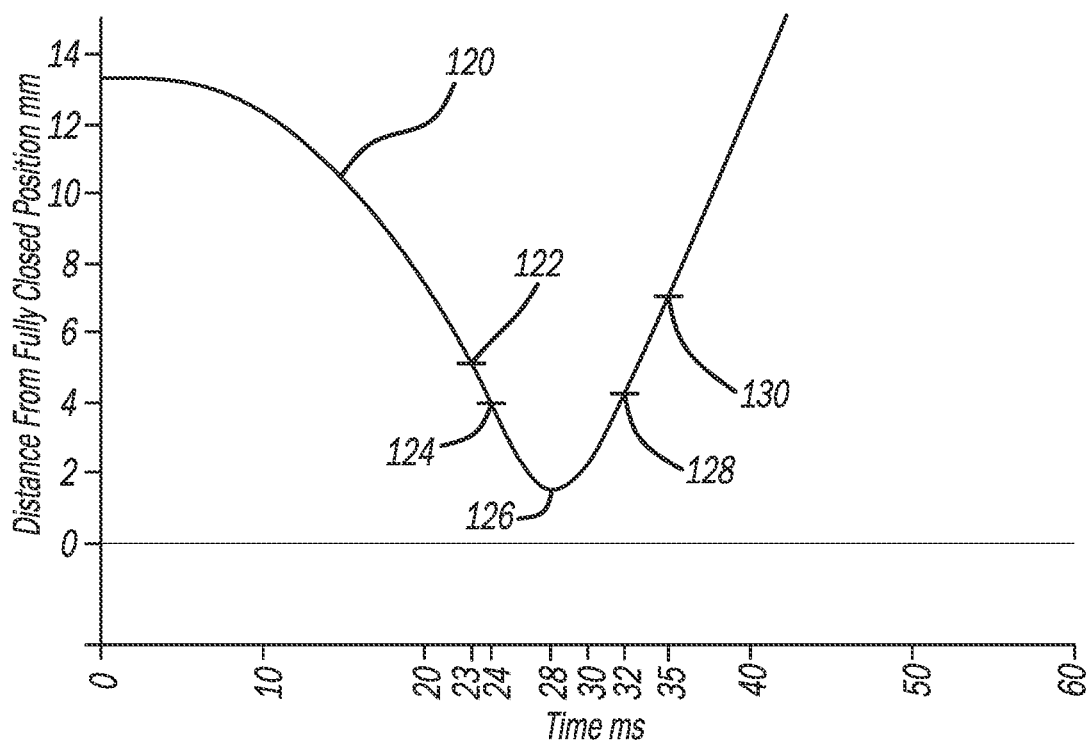


FIG - 5

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LOW ENERGY RECLOSING PULSE TEST**CROSS-REFERENCE TO RELATED APPLICATION**

This application claims the benefit of priority from the U.S. Provisional Application No. 62/944,296, filed on Dec. 5, 2019, the disclosure of which is hereby expressly incorporated herein by reference for all purposes.

BACKGROUND**Field**

The present disclosure relates generally to a system and method for performing a low energy pulse testing operation in a power distribution network to determine if a fault condition is present.

Discussion of the Related Art

An electrical power distribution network, often referred to as an electrical grid, typically includes a number of power generation plants each having a number of power generators, such as gas turbines, nuclear reactors, coal-fired generators, hydro-electric dams, etc. The power plants provide power at a variety of medium voltages that are then stepped up by transformers to a high voltage AC signal to be connected to high voltage transmission lines that deliver electrical power to a number of substations typically located within a community, where the voltage is stepped down by transformers to a medium voltage for distribution. The substations provide the medium voltage power to a number of three-phase feeders including three single-phase feeder lines that provide medium voltage to various distribution transformers and lateral line connections. A number of three-phase and single-phase lateral lines are tapped off of the feeder that provide the medium voltage to various distribution transformers, where the voltage is stepped down to a low voltage and is provided to a number of loads, such as homes, businesses, etc.

Power distribution networks of the type referred to above typically include a number of switching devices, breakers, reclosers, interrupters, etc. that control the flow of power throughout the network. A vacuum interrupter is a switch that has particular application for many of these types of devices. A vacuum interrupter employs opposing contacts, one fixed and one movable, positioned within a vacuum enclosure. When the interrupter is opened by moving the movable contact away from the fixed contact the arc that is created between the contacts is quickly extinguished as the AC current goes through zero in the vacuum. A vapor shield is typically provided around the contacts to contain the by-products of the arcing. For certain applications, the vacuum interrupter is encapsulated in a solid insulation housing that may have a grounded external surface.

Periodically, faults occur in the distribution network as a result of various things, such as animals touching the lines, lightning strikes, tree branches falling on the lines, vehicle collisions with utility poles, etc. Faults may create a short-circuit that increases the stress on the network, which may cause the current flow from the substation to significantly increase, for example, many times above the normal current, along the fault path. This amount of current causes the electrical lines to significantly heat up and possibly melt, and also could cause mechanical damage to various components in the substation and in the network. These faults are many

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times transient or intermittent faults as opposed to a persistent or bolted fault, where the thing that caused the fault is removed a short time after the fault occurs, for example, a lightning strike. In such cases, the distribution network will almost immediately begin operating normally after a brief disconnection from the source of power.

Fault interrupters, for example, reclosers that employ vacuum interrupters, are provided on utility poles and in underground circuits along a power line and have a switch to allow or prevent power flow downstream of the recloser. These reclosers detect the current and voltage on the line to monitor current flow and have controls that indicate problems with the network circuit, such as detecting a high current fault event. If such a high fault current is detected the recloser is opened in response thereto, and then after a short delay closed to determine whether the fault is a transient fault. If a high fault current flows when the recloser is closed after opening, it is immediately re-opened. If the fault current is detected a second time, or multiple times, during subsequent opening and closing operations indicating a persistent fault, then the recloser remains open, where the time between detection tests may increase after each test. For a typical reclosing operation for fault detection tests, about 3-6 cycles or 50 to 100 ms of fault current pass through the recloser before it is opened, but testing on delayed curves can allow fault current to flow for much longer times.

When a fault is detected, it is desirable that the first fault interrupter upstream from the fault be opened as soon as possible so that the fault is quickly removed from the network so that the loads upstream of that fault interrupter are not disconnected from the power source and service is not interrupted to them. It is further desirable that if the first fault interrupter upstream from the fault does not open for whatever reason, then a next fault interrupter upstream from the fault is opened, and so on. In order to accomplish this, it is necessary that some type of communications or coordination protection scheme be employed in the network so that the desired fault interrupter is opened in response to the fault.

During the traditional reclosing operation discussed above, the vacuum interrupter contacts in the recloser are closed without regard to a desired phase angle. This results in a random closing angle that often creates an asymmetrical fault current, where the current cycle is offset from zero, i.e., has high magnitude peaks in one polarity and lower peaks in the reverse polarity relative to zero. The high magnitude fault current peaks, depending on the length of time they are occurring, causes significant forces and stresses on the components in the network that may reduce their life. For the traditional reclosing operation having current flow times over 3-6 cycles and longer times for delayed curve operation, these forces and stresses can be considerable. When considering the life of a transformer winding, one cause of end of life can be fatigue in the winding, which is the accumulation of high mechanical and thermal stress cycles. Stress is the result of the current in the winding, where higher current results in higher stress. Doubling the stress that can cause fatigue from the asymmetrical fault currents described above can result in a tenfold or more reduction in fatigue life, i.e., the life before fatigue causes cracking. This stress can be reduced by reducing the peak current and by reducing the number of stress cycles.

In order to overcome this problem, reclosers have been developed in the art that use pulse testing technologies where the closing and then opening of the vacuum interrupter contacts is performed in a pulsed manner so that the

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full fundamental frequency multiple cycle fault current is not applied to the network while the recloser is testing to determine if the fault is still present. Typically these pulses are about one-half of a fundamental frequency current cycle. Additionally, these reclosers close at the appropriate point on the voltage waveform to eliminate the asymmetrical current, which reduces the stresses due to high current in the components.

Pulse closing technologies have been successful in significantly reducing fault current stresses on network equipment during recloser testing. However, the switching devices required to generate these short pulse durations are relatively complicated and expensive. For example, vacuum interrupters employed to generate these pulses often use two magnetic actuators, one to close the contacts and one to quickly open the contacts using the moving mass of the opening actuator to reverse the direction of the closing actuator, well understood by those skilled in the art.

SUMMARY

The following discussion discloses and describes a system and method for performing a low energy pulse testing operation in a power distribution network that causes recloser contacts to close and then open in such a way that produces current flow for one fundamental frequency cycle after closing on a voltage waveform that produces symmetrical current. The method includes energizing a magnetic actuator to move the movable contact towards the fixed contact, where AC current conducts across a gap between the movable contact and the fixed contact before the movable contact and the fixed contact make contact. The actuator movement to close the contacts pushes against the bias of at least one opening spring coupled to the movable contact. A compliance spring coupled to the movable contact with some preload is compressed further as the two contacts touch. The method also includes de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator when the movable contact makes contact with the fixed contact so as to allow the bias of the opening and compliance springs to first compress absorbing energy from the motion of the moving mass, then to expand moving the movable contact away from the fixed contact so that the amount of time that the current conducts between the movable contact and the fixed contact is about one fundamental frequency cycle, and where energizing the magnetic actuator occurs at a time at or near a peak of the voltage wave so that the current through the switch assembly is symmetric.

Additional features of the disclosure will become apparent from the following description and appended claims, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a simplified schematic illustration of an electrical power distribution network;

FIG. 2 is a side, cross-sectional type view of a magnetic actuator switch assembly in an open position that can be used in a recloser in the power distribution network shown in FIG. 1;

FIG. 3 is a side, cross-sectional type view of the magnetic actuator switch assembly shown in FIG. 2 in a closed position;

FIG. 4 is a graph with time on the horizontal axis and magnitude on the vertical axis showing a relationship between symmetrical and asymmetrical current relative to voltage angle; and

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FIG. 5 is a graph with time on the horizontal axis and actuator housing position on the vertical axis showing position versus time of the actuator housing in the switch assembly.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The following discussion of the embodiments of the disclosure directed to a system and method for performing a low energy fault pulse testing operation in a power distribution network that causes recloser contacts to close and then open in approximately one fundamental frequency cycle of current flow time and close on a voltage waveform that produces symmetrical fault current is merely exemplary in nature, and is in no way intended to limit the invention or its applications or uses.

The present disclosure proposes a system and method that replaces the known fault pulse testing process in a power distribution network with a low energy fault pulse testing process, which results in lower cost switching devices. The method includes controlling the position of the switch contacts in a recloser so that they conduct for a short time duration that limits the current conduction time to one fundamental frequency cycle. The method also includes closing the switch contacts at a point on the voltage waveform that results in the flow of symmetrical current instead of asymmetrical current, which is accomplished by recognizing that asymmetrical currents occur from closing the contacts at a certain voltage angle, where the preferred angle for asymmetrical current is at or near the peak of the voltage waveform. The disclosed low energy testing process is distinguished from the conventional recloser random closing operation since the recloser protection functions perform their normal fault detection processes, thereby extending the potential fault duration to several power system cycles or a much longer time.

FIG. 1 is a schematic type diagram of an electrical power distribution network 10 including an electrical substation 12 that steps down high voltage power from a high voltage power line (not shown) to medium voltage power, a three-phase feeder 14 that receives medium voltage power from the substation 12, and a lateral line 16 that receives the medium voltage power from the feeder 14. The medium voltage is stepped down to a low voltage by a number of distribution transformers 18 strategically positioned along the lateral line 16, and the low voltage is then provided through a secondary service conductor 38 to a number of loads 20 represented here as homes. The lateral line 16 includes a fuse 28 positioned between the feeder 14 and the first load 20 on the lateral line 16 proximate to a tap location where the lateral line 16 is connected to the feeder 14. The fuse 28 is an independent electrical device that is not in communication with other components or devices in the network 10, where the fuse 28 creates an open circuit if an element within the fuse 28 heats up above a predetermined temperature as a result of high fault current so as to prevent short-circuit faults on the lateral line 16 from affecting other parts of the network 10.

The network 10 includes a number of reclosers of the type referred to above provided at certain intervals along the feeder 14 represented by reclosers 24 and 26 that receive the medium voltage from the substation 12 on the feeder 14. Although only shown as a single line, the feeder 14 would include three lines, one for each phase, where a three-phase or three separate reclosers would be provided in each line. A number of utility poles 22 are provided along the feeder

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14 and the lateral line 16, where the recloser 24 would be mounted on certain ones of the poles 22. The recloser 24 includes a vacuum interrupter switch or other switching device 30 for opening and closing the recloser 24 to allow or prevent current flow therethrough on the feeder 14, where the switch 30 is capable of providing pulses for pulse testing consistent with the discussion herein. The recloser 24 also includes sensors 32 for measuring the current and voltage of the power signal propagating on the feeder 14, an electronic controller 34 for processing the measurement signals and controlling the position of the switch 30, and an optional transceiver 36 for transmitting data and messages to a control facility and/or to other reclosers and components in the system 10. The configuration and operation of reclosers and switching devices of this type are well understood by those skilled in the art.

FIG. 2 is a side, cross-sectional type view of a magnetic actuator switch assembly 50 in an open position and FIG. 3 is a side, cross-sectional type view of the switch assembly 50 in a closed position, where the switch assembly 50 can be used in the switch 30. The switch assembly 50 includes a fixed contact 52 and a movable contact 54 having a defined mass, for example, 0.4 kg, that would be positioned in, for example, a vacuum bottle of a vacuum interrupter, where the contacts 52 and 54 are shown spaced apart from each other across a vacuum gap 56 in the open position, and where the distance of the gap 56 is determined so as to prevent conduction between the contacts 52 and 54 in the open position based on the voltages employed in the network 10. The switch assembly 50 further includes an actuator 58 having an actuator housing 60 with a wide housing portion 62 and a narrow housing portion 64. An open spring 66 is wound around the narrow housing portion 64 and is positioned against the wide housing portion 62 and a conductive structure 68, where the current path on the power line flows through a current transfer coupling 70 coupled to the structure 68 and the movable contact 54. A flange 72 attached to the movable contact 54 opposite from the gap 56 is positioned within the narrow housing portion 64 and engages a flange 74 at an end of the narrow housing portion 64 opposite to the wide housing portion 62. A compliance spring 78 is positioned in the narrow housing portion 64 against the flange 72 and a wall 80, where the spring 78 has, in one non-limiting embodiment, a 266 Newton preload and a 334 Newton full deflection. The actuator 58 further includes a solenoid 84 positioned within the wide housing portion 62 and including a core 86, a coil 88 wrapped around a center portion 90 of the core 86 and movable core 92 attached to the housing 60, where a gap 102 is provided between the movable core 92 and the core 86 when the contacts 52 and 54 are open. The core 86 is an E-shaped core in this non-limiting embodiment, where other shaped cores may be applicable such as round pot cores. A plunger 94 is secured to a fixed member 96 by a spring 98 and having a coil 100 wrapped around it.

To close the contacts 52 and 54, the coil 88 is energized so that magnetic flux across the gap 102 between the magnetic elements draws the movable core 92 towards the E-shaped core 86, which moves the housing 60 against the bias of the open spring 66 and causes the compliance spring 78 to push the movable contact 54 against the fixed contact 52, where the bias of the springs 66 and 78 hold the contacts 52 and 54 together in a tight engagement. The coil 100 is de-energized which causes the spring 98 to move the plunger 94 upwards and hold the actuator 58 in the closed position. To open the contacts 52 and 54, the coil 100 is energized to pull the plunger 94 downward against the friction of the

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moving part of the actuator 58 and the bias of the spring 98 so that the open spring 66 and the compliance spring 78 push the housing 60 to the left and moves the movable core 92 away from the E-shaped core 86. Since it is necessary to quickly open the contacts 52 and 54 when fault current is detected, the spring forces used to move the contact 54 away from the contact 52 are relatively high. Additionally, it is desirable to coordinate the opening of the contacts 52 and 54 with other reclosers so that those reclosers closest to the fault are opened first, which requires a force to be applied to the movable contact 54 to hold the contacts 52 and 54 closed for some period of time when a fault is detected to coordinate with faster reclosers.

As mentioned above, this disclosure describes a low energy fault pulse testing process that causes about one fundamental frequency cycle of symmetrical current during each pulse test. Process algorithms control the switch assembly 50 to provide point-on-wave closing of the contacts 52 and 54 to obtain the short duration symmetric current flow that includes controlling the relative position of the vacuum interrupter contacts 52 and 54 to provide the desired time to start and end current conduction across the contacts 52 and 54 by controlling the time when the actuator 58 begins moving to close the contacts 52 and 54 and controlling when the coil 88 is turned off. FIGS. 4 and 5 are graphs to help illustrate the control of the switch assembly 50 in this manner.

FIG. 4 is a graph with time on the horizontal axis and magnitude on the vertical axis showing a relationship between symmetrical and asymmetrical current relative to a voltage waveform. Graph line 110 is the measured voltage at the switch assembly 50 during the fault and shows the zero cross-overs of the voltage signal. Graph line 112 shows the measured fault current at the switch assembly 50 if the contacts 52 and 54 begin conduction at a zero cross-over of the voltage, and shows the current being offset or asymmetrical where the positive peaks are much higher in absolute magnitude than the negative peaks, which leads to significant stress on the electrical components in the network 10 that are subjected to the fault current because of the high current magnitude. Graph line 114 shows the measured fault current if the contacts 52 and 54 begin conducting at a voltage angle 90°, and shows the current being symmetrical where the positive and negative peak values are at the same magnitude relative to zero. Thus, although the peak-to-peak current is the same for symmetrical and asymmetrical currents, the absolute magnitude of the peaks is less for symmetrical current, which reduces the stress on the electrical components in the network 10 that are subjected to the fault current.

FIG. 5 is a graph with time on the horizontal axis and the position of the actuator housing 60 on the vertical axis, where graph line 120 shows the position of the actuator housing 60 from when it starts moving to close the contacts 52 and 54 until it returns to the contact open position. The zero position is the position of the actuator housing 60 where the movable core 92 is touching the E-shaped core 86, as shown in FIG. 3. When the coil 88 is energized and the actuator housing 60 moves to close the contacts 52 and 54, initially compressing the springs 66 as the movable contact 54 is moved towards the fixed contact 52, the gap 56 will be reduced. When the position of the actuator housing 60 is at about 5 mm shown by point 122 at about time 23 ms, the gap 56 is about 1 mm, and conduction between the contacts 52 and 54 will begin across the gap 56, known as a pre-strike. As the actuator housing 60 continues to move, the contacts 52 and 54 will engage at actuator position of about 4 mm

shown by point 124 at about time 24 ms, and the current to the coil 88 will be shut off. The momentum of the actuator housing 60 will continue moving the actuator housing 60 until the position of the actuator housing 60 is about 1.5 mm at point 126 at about time 28 ms, shown as a gap 104 between the flanges 72 and 74 in FIG. 3, when the compression forces of the springs 66 and 78 are holding the contacts 52 and 54 closed and the actuator housing 60 will reverse its direction. At point 128, about time 32 ms, the contacts 52 and 54 will separate, but there still is conduction across the gap 56 until the gap length is about 3 mm, which occurs at point 130 at about time 35 ms. One fundamental frequency cycle at 60 Hz is about 16.7 ms for 60 Hz, so the time from the beginning of the conduction at time 23 ms until the end of conduction at time 35 ms is 12 ms, which is about three-fourths of the cycle, where the current stops at the next zero current crossing. Thus, the current conduction time through the contacts 52 and 54 is one fundamental frequency cycle at 60 Hz. These times can be adjusted for systems that operate at other frequencies.

The control of the switch assembly 50 as being described includes driving the movable contact 54 into the fixed contact 52 and then immediately turning off the current applied to the coil 88, or reversing the voltage on the coil 88 to drive the coil current to zero, so that the closing force between the contacts 52 and 54 is only provided by the momentum of the actuator 58 and the mass of the movable contact 54 against the forces provided by the open spring 66 and the compliance spring 78, which bounces the movable contact 54 off of the fixed contact 52. In other words, the velocity of the actuator 58 after the coil 88 is turned off, or otherwise has zero coil current, compresses the compliance spring 78 until the stored energy in the moving mass of the actuator 58 and the movable contact 54 is transferred to the compliance spring 78, where the compliance spring 78 will push the contacts 52 and 54 back open again. Thus, by intentionally bouncing the contacts 52 and 54 for the low energy test in this manner, the potential fault current duration is limited to one fundamental frequency current cycle as described. Specifically, the control of the switch assembly 50 is capable of opening the vacuum interrupter contacts 52 and 54 fast enough to be able to interrupt current flow within 16.7 ms of the first conduction between the contacts 52 and 54, which gives a total conduction time from closing to opening the contacts 52 and 54 less than 16.7 ms as measured from a 1 mm open pre-strike contact gap to a 3 mm open contact gap. This results in one fundamental frequency current cycle of symmetrical fault current, which is twice the time that the present single pulse would allow as known pulse testing a faulted circuit results in a half-cycle of fault current. These times can be adjusted for systems that operate at other frequencies.

Thus, the switch assembly 50 is designed so that the moving mass of the actuator 58 and the movable contact 54, the size and length of the compliance spring 78, the amount of current applied to the coil 88, the time that the current is removed from the coil 88 during the closing operation, etc. cause the contacts 52 and 54 to conduct for about one fundamental frequency cycle of fault current. Since the control of the switch assembly 50 allows control of the position of the movable contact 54 relative to time, the timing of the conduction between the contacts 52 and 54 can be controlled so that current begins flowing at a 90° angle of the voltage waveform so that symmetrical currents flow instead of asymmetrical currents when the contacts 52 and 54 are closed, which reduces forces on the network components. Further, traditional vacuum interrupters can be

employed instead of more complex and specialized vacuum interrupters required for the known pulse testing.

Another embodiment includes closing the vacuum interrupter contacts 52 and 54 at the voltage peak that drives transformers away from saturation, thereby keeping the transformers from saturating, where when a transformer is de-energized there is often a non-zero remnant flux in the transformer core. Energization in-rush current results from saturation of the transformer core when it is energized at a voltage point where the new flux drives the transformer into saturation. This can be reduced/eliminated by keeping a flux model of transformers in some form of memory, closing the vacuum interrupter contacts 52 and 54 so that the flux will move toward zero rather than away from zero. If the residual flux is the result of positive voltage the vacuum interrupter contacts 52 and 54 close when the voltage is negative moving the flux toward zero and minimizing the peak flux that drives the transformer core into saturation. The flux at peak voltage is zero because it lags the voltage by 90°. If this is the case, the point-on-wave can be adjusted to correct the residual flux by closing slightly earlier than the peak of the voltage waveform.

Many of the examples used in this discussion were derived for power systems operating at 60 Hz fundamental frequency. It is noted that similar techniques can be applied to adjust the mechanism to operate at other fundamental frequencies.

The foregoing discussion discloses and describes merely exemplary embodiments of the present disclosure. One skilled in the art will readily recognize from such discussion and from the accompanying drawings and claims that various changes, modifications and variations can be made therein without departing from the spirit and scope of the disclosure as defined in the following claims.

What is claimed is:

1. A method for operating a magnetically actuated switch assembly to perform a low energy test pulse, the switch assembly including a fixed contact and a movable contact, the method comprising:

energizing a magnetic actuator to move the actuator against the bias of at least one spring coupled to the movable contact towards the fixed contact to make contact therebetween, wherein AC current conducts across a gap between the movable contact and the fixed contact before the movable contact and the fixed contact make contact; and

de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator when the movable contact makes contact with the fixed contact so as to allow the bias of the at least one spring to move the movable contact away from the fixed contact so that the amount of time that the current conducts between the movable contact and the fixed contact is about one fundamental frequency cycle of the current, wherein energizing the magnetic actuator occurs at a time so that when the movable contact and the fixed contact begin conducting an applied voltage on the switch assembly is at or near a peak of the voltage wave so that the current is symmetric.

2. The method according to claim 1 wherein the at least one spring is a larger open spring and a smaller compliance spring.

3. The method according to claim 2 wherein the open spring is wrapped around a cylindrical housing and the compliance spring is provided within the housing.

4. The method according to claim 3 wherein the magnetic actuator includes a stationary core having a coil and a

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movable core that moves towards the stationary core when the actuator is energized, and wherein de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator includes removing or reversing a voltage applied to the coil.

5. The method according to claim 1 wherein the one fundamental frequency cycle of current is about 16.7 ms for 60 Hz.

6. The method according to claim 5 wherein the time that the contacts begin conducting to the time the contacts will withstand voltage when the current goes to zero is about three-quarters of the one fundamental frequency cycle time.

7. The method according to claim 1 wherein the voltage on the switch assembly that is at or near the peak of the voltage wave is at a 90° voltage angle.

8. The method according to claim 1 wherein the contacts are part of a vacuum interrupter.

9. The method according to claim 8 wherein the current is a fault current in a medium voltage power distribution network and the vacuum interrupter is part of a recloser in the power distribution network.

10. A method for performing a reclosing fault testing operation in a power distribution network using a vacuum interrupter including a fixed contact and a movable contact, the method comprising:

energizing a magnetic actuator to move the actuator against the bias of at least one spring coupled to the movable contact towards the fixed contact to make contact therebetween, wherein AC fault current conducts across a gap between the movable contact and the fixed contact before the movable contact and the fixed contact make contact; and

de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator when the movable contact makes contact with the fixed contact so as to allow the bias of the at least one spring to move the movable contact away from the fixed contact so that the amount of time that the current conducts between the movable contact and the fixed contact is about one fundamental frequency cycle of the fault current.

11. The method according to claim 10 wherein the one fundamental frequency cycle of current is about 16.7 ms for 60 Hz.

12. The method according to claim 11 wherein the time that the contacts begin conducting to the time the contacts will withstand voltage when the current goes to zero is about three-quarters of the one fundamental frequency cycle time.

13. The method according to claim 10 wherein the at least one spring is a larger open spring and a smaller compliance spring.

14. A method for performing a low energy pulse testing operation in a power distribution network using a vacuum interrupter including a fixed contact and a movable contact, the method comprising:

energizing a magnetic actuator to move the actuator against the bias of at least one spring coupled to the movable contact towards the fixed contact to make

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contact therebetween, wherein AC fault current conducts across a gap between the movable contact and the fixed contact before the movable contact and the fixed contact make contact; and

de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator so as to allow the bias of the at least one spring to move the movable contact away from the fixed contact, wherein energizing the magnetic actuator occurs at a time so that when the movable contact and the fixed contact begin conducting an applied voltage on the switch assembly is at or near a peak of the voltage wave so that the fault current is symmetric.

15. The method according to claim 14 wherein the voltage on the switch assembly that is at or near the peak of the voltage wave is at a 90° voltage angle.

16. The method according to claim 14 wherein the at least one spring is a larger open spring and a smaller compliance spring.

17. A system for using a magnetically actuated switch assembly to produce a low energy pulse test, the switch assembly including a fixed contact and a movable contact, the system comprising:

means for energizing a magnetic actuator to move the actuator against the bias of at least one spring coupled to the movable contact towards the fixed contact to make contact therebetween, wherein AC current conducts across a gap between the movable contact and the fixed contact before the movable contact and the fixed contact make contact; and

means for de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator when the movable contact makes contact with the fixed contact so as to allow the bias of the at least one spring to move the movable contact away from the fixed contact so that the amount of time that the current conducts between the movable contact and the fixed contact is about one fundamental frequency cycle of the current, wherein energizing the magnetic actuator occurs at a time so that when the movable contact and the fixed contact begin conducting an applied voltage on the switch assembly is at or near a peak of the voltage wave so that the current is symmetric.

18. The system according to claim 17 wherein the one fundamental frequency cycle of current is about 16.7 ms for 60 Hz.

19. The system according to claim 18 wherein the time that the contacts begin conducting to the time the contacts will withstand voltage when the current goes to zero is about three-quarters of the one fundamental frequency cycle time.

20. The method according to claim 17 wherein the voltage on the switch assembly that is at or near the peak of the voltage wave is at a 90° voltage angle.

* * * * *

CLAIMS

What is Claimed is:

1. A method for operating a magnetically actuated switch assembly to perform a low energy test pulse, the switch assembly including a fixed contact and a movable contact, the method comprising:

energizing a magnetic actuator to move the actuator against the bias of at least one spring coupled to the movable contact towards the fixed contact to make contact therebetween, wherein AC current conducts across a gap between the movable contact and the fixed contact before the movable contact and the fixed contact make contact; and

de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator when the movable contact makes contact with the fixed contact so as to allow the bias of the at least one spring to move the movable contact away from the fixed contact so that the amount of time that the current conducts between the movable contact and the fixed contact is about one fundamental frequency cycle of the current, wherein energizing the magnetic actuator occurs at a time so that when the movable contact and the fixed contact begin conducting an applied voltage on the switch assembly is at or near a peak of the voltage wave so that the current is symmetric.

2. The method according to claim 1 wherein the at least one spring is a larger open spring and a smaller compliance spring.

3. The method according to claim 2 wherein the open spring is wrapped around a cylindrical housing and the compliance spring is provided within the housing.

4. The method according to claim 3 wherein the magnetic actuator includes a stationary core having a coil and a movable core that moves towards the stationary core when the actuator is energized, and wherein de-energizing

the magnetic actuator or reversing the voltage on the magnetic actuator includes include removing or reversing a voltage applied to the coil.

5. The method according to claim 1 wherein the one fundamental frequency cycle of current is about 16.7 ms for 60 Hz.

6. The method according to claim 5 wherein the time that the contacts begin conducting to the time the contacts will withstand voltage when the current goes to zero is about three-quarters of the one fundamental frequency cycle time.

7. The method according to claim 1 wherein the voltage on the switch assembly that is at or near the peak of the voltage wave is at a 90° voltage angle.

8. The method according to claim 1 wherein the contacts are part of a vacuum interrupter.

9. The method according to claim 8 wherein the current is a fault current in a medium voltage power distribution network and the vacuum interrupter is part of a recloser in the power distribution network.

10. A method for performing a reclosing fault testing operation in a power distribution network using a vacuum interrupter including a fixed contact and a movable contact, the method comprising:

energizing a magnetic actuator to move the actuator against the bias of at least one spring coupled to the movable contact towards the fixed contact to make contact therebetween, wherein AC fault current conducts across a gap between the movable contact and the fixed contact before the movable contact and the fixed contact make contact; and

de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator when the movable contact makes contact with the fixed contact so as to allow the bias of the at least one spring to move the movable contact away from the fixed contact so that the amount of time that the current conducts between the movable contact and the fixed contact is about one fundamental frequency cycle of the fault current.

11. The method according to claim 10 wherein the one fundamental frequency cycle of current is about 16.7 ms for 60 Hz.

12. The method according to claim 11 wherein the time that the contacts begin conducting to the time the contacts will withstand voltage when the current goes to zero is about three-quarters of the one fundamental frequency cycle time.

13. The method according to claim 10 wherein the at least one spring is a larger open spring and a smaller compliance spring.

14. A method for performing a low energy pulse testing operation in a power distribution network using a vacuum interrupter including a fixed contact and a movable contact, the method comprising:

energizing a magnetic actuator to move the actuator against the bias of at least one spring coupled to the movable contact towards the fixed contact to make contact therebetween, wherein AC fault current conducts across a gap between the movable contact and the fixed contact before the movable contact and the fixed contact make contact; and

de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator so as to allow the bias of the at least one spring to move the movable contact away from the fixed contact, wherein energizing the magnetic actuator occurs at a time so that when the movable contact and the fixed contact

begin conducting an applied voltage on the switch assembly is at or near a peak of the voltage wave so that the fault current is symmetric.

15. The method according to claim 14 wherein the voltage on the switch assembly that is at or near the peak of the voltage wave is at a 90° voltage angle.

16. The method according to claim 14 wherein the at least one spring is a larger open spring and a smaller compliance spring.

17. A system for using a magnetically actuated switch assembly to produce a low energy pulse test, the switch assembly including a fixed contact and a movable contact, the system comprising:

means for energizing a magnetic actuator to move the actuator against the bias of at least one spring coupled to the movable contact towards the fixed contact to make contact therebetween, wherein AC current conducts across a gap between the movable contact and the fixed contact before the movable contact and the fixed contact make contact; and

means for de-energizing the magnetic actuator or reversing the voltage on the magnetic actuator when the movable contact makes contact with the fixed contact so as to allow the bias of the at least one spring to move the movable contact away from the fixed contact so that the amount of time that the current conducts between the movable contact and the fixed contact is about one fundamental frequency cycle of the current, wherein energizing the magnetic actuator occurs at a time so that when the movable contact and the fixed contact begin conducting an applied voltage on the switch assembly is at or near a peak of the voltage wave so that the current is symmetric.

18. The system according to claim 17 wherein the one fundamental frequency cycle of current is about 16.7 ms for 60 Hz.

19. The system according to claim 18 wherein the time that the contacts begin conducting to the time the contacts will withstand voltage when the current goes to zero is about three-quarters of the one fundamental frequency cycle time.

20. The method according to claim 17 wherein the voltage on the switch assembly that is at or near the peak of the voltage wave is at a 90° voltage angle.

REIVINDICACIONES

Lo que se reivindica es:

1. Un método para operar un conjunto del interruptor accionado magnéticamente para realizar un pulso de prueba de baja energía, el conjunto del interruptor incluye un contacto fijo y un contacto móvil, el método que comprende:

energizar un actuador magnético para mover el actuador contra la polarización de al menos un resorte acoplado al contacto móvil hacia el contacto fijo para hacer contacto entre ellos, en donde la corriente de CA se conduce a través de un espacio entre el contacto móvil y el contacto fijo antes de que el contacto móvil y el contacto fijo hagan contacto; y

desenergizar el actuador magnético o invertir el voltaje en el actuador magnético cuando el contacto móvil hace contacto con el contacto fijo para permitir que la polarización de al menos un resorte aleje el contacto móvil del contacto fijo para que la cantidad de tiempo que la corriente conduce entre el contacto móvil y el contacto fijo sea aproximadamente un ciclo de frecuencia fundamental de la corriente, en donde la energización del actuador magnético ocurre en un momento en que cuando el contacto móvil y el contacto fijo comienzan a conducir un voltaje aplicado en el conjunto del interruptor está en o cerca de un pico de la onda del voltaje para que la corriente sea simétrica.

2. El método según la reivindicación 1, en donde al menos un resorte es un resorte abierto más grande y un resorte de flexibilidad más pequeño.

3. El método según la reivindicación 2, en donde el resorte abierto se envuelve alrededor de una carcasa cilíndrica y el resorte de flexibilidad se proporciona dentro de la carcasa.

4. El método según la reivindicación 3, en donde el actuador magnético incluye un núcleo estacionario que tiene una bobina y un núcleo móvil que se mueve hacia el núcleo estacionario cuando se energiza el actuador, y en donde el

desenergizar el actuador magnético o invertir el voltaje en el actuador magnético incluye quitar o invertir un voltaje aplicado a la bobina.

5. El método según la reivindicación 1, en donde el ciclo de frecuencia fundamental de la corriente es de aproximadamente 16,7 ms para 60 Hz.

6. El método según la reivindicación 5, en donde el tiempo en que los contactos comienzan a conducir hasta el momento en que los contactos resistirán el voltaje cuando la corriente llegue a cero es aproximadamente las tres cuartas partes del tiempo de ciclo de una frecuencia fundamental.

7. El método según la reivindicación 1, en donde el voltaje en el conjunto del interruptor que está en o cerca del pico de la onda del voltaje está en un ángulo de voltaje de 90°.

8. El método según la reivindicación 1, en donde los contactos son parte de un interruptor de vacío.

9. El método según la reivindicación 8, en donde la corriente es una corriente de falla en una red de distribución de energía de voltaje medio y el interruptor de vacío es parte de un reconectador en la red de distribución de energía.

10. Un método para realizar una operación de prueba de falla de reconexión en una red de distribución de energía utilizando un interruptor de vacío que incluye un contacto fijo y un contacto móvil, el método que comprende:

energizar un actuador magnético para mover el actuador contra la polarización de al menos un resorte acoplado al contacto móvil hacia el contacto fijo para hacer contacto entre ellos, en donde la corriente de falla de CA se conduce a través de un espacio entre el contacto móvil y el contacto fijo antes del contacto móvil y el contacto fijo hagan contacto; y

desenergizar el actuador magnético o invertir el voltaje en el actuador magnético cuando el contacto móvil hace contacto con el contacto fijo para permitir que la polarización del al menos un resorte aleje el contacto móvil del contacto fijo para que la cantidad de tiempo que la corriente conduce entre el contacto móvil y el contacto fijo sea aproximadamente un ciclo de frecuencia fundamental de la corriente de falla.

11. El método según la reivindicación 10, en donde el ciclo de frecuencia fundamental de la corriente es de aproximadamente 16,7 ms para 60 Hz.

12. El método según la reivindicación 11, en donde el tiempo en que los contactos comienzan a conducir hasta el momento en que los contactos resistirán el voltaje cuando la corriente llegue a cero es aproximadamente las tres cuartas partes del tiempo de ciclo de una frecuencia fundamental.

13. El método según la reivindicación 10, en donde al menos un resorte es un resorte abierto más grande y un resorte de flexibilidad más pequeño.

14. Un método para realizar una operación de prueba del pulso de baja energía en una red de distribución de energía utilizando un interruptor de vacío que incluye un contacto fijo y un contacto móvil, el método que comprende:

energizar un actuador magnético para mover el actuador contra la polarización de al menos un resorte acoplado al contacto móvil hacia el contacto fijo para hacer contacto entre ellos, en donde la corriente de falla de CA se conduce a través de un espacio entre el contacto móvil y el contacto fijo antes del contacto móvil y el contacto fijo hagan contacto; y

desenergizar el actuador magnético o invertir el voltaje en el actuador magnético para permitir que la polarización del al menos un resorte aleje el contacto móvil del contacto fijo, en donde la energización del actuador magnético ocurre en un momento en que cuando el contacto móvil y el contacto fijo comienzan a conducir

un voltaje aplicado en el conjunto del interruptor está en o cerca del pico de la onda del voltaje para que la corriente de falla sea simétrica.

15. El método según la reivindicación 14, en donde el voltaje en el conjunto del interruptor que está en o cerca del pico de la onda del voltaje está en un ángulo de voltaje de 90°.

16. El método según la reivindicación 14, en donde al menos un resorte es un resorte abierto más grande y un resorte de flexibilidad más pequeño.

17. Un sistema para usar un conjunto del interruptor accionado magnéticamente para producir una prueba de pulso de baja energía, el conjunto del interruptor incluye un contacto fijo y un contacto móvil, el sistema que comprende:

medios para energizar un actuador magnético para mover el actuador contra la polarización de al menos un resorte acoplado al contacto móvil hacia el contacto fijo para hacer contacto entre ellos, en donde la corriente de CA se conduce a través de un espacio entre el contacto móvil y el contacto fijo antes de que el contacto móvil y el contacto fijo hagan contacto; y

medios para desenergizar el actuador magnético o invertir el voltaje en el actuador magnético cuando el contacto móvil hace contacto con el contacto fijo para permitir que la polarización del al menos un resorte aleje el contacto móvil del contacto fijo para que la cantidad de tiempo que la corriente conduce entre el contacto móvil y el contacto fijo es aproximadamente un ciclo de frecuencia fundamental de la corriente, en donde la energización del actuador magnético ocurre en un momento en que cuando el contacto móvil y el contacto fijo comienzan a conducir un voltaje aplicado en el conjunto del interruptor está en o cerca de un pico de la onda del voltaje para que la corriente sea simétrica.

18. El sistema según la reivindicación 17, en donde el ciclo de frecuencia fundamental de la corriente es de aproximadamente 16,7 ms para 60 Hz.

19. El sistema según la reivindicación 18, en donde el tiempo en que los contactos comienzan a conducir hasta el momento en que los contactos resistirán el voltaje cuando la corriente llegue a cero es aproximadamente las tres cuartas partes del tiempo de ciclo de una frecuencia fundamental.

20. El método según la reivindicación 17, en donde el voltaje en el conjunto del interruptor que está en o cerca del pico de la onda del voltaje está en un ángulo de voltaje de 90° .