

P-4598

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO  
DIRECCIÓN DE NUEVAS CREACIONES

E. S. D.

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 13-197868-00006-0000

Fecha: 2014-11-20 16:04:48 Dep. 2010 DIR.SIGNOSDIS  
Tra. 1 MARCAS Eve: 4 REGDEPOSITO  
Act. 444 RESPUESTAREQUE Folios: 54

Ref.: Expediente No. 14.197.868

Solicitud de patente a nombre de

HARNISCHFEGER TECHNOLOGIES, INC.

Yo, SILVANA MARIA LÓPEZ DÍAZ, identificada como aparece al pie de mi firma, domiciliada en la Carrera 11 No. 86-53, piso 6, obrando como apoderada de la sociedad HARNISCHFEGER TECHNOLOGIES, INC., solicitante de la patente de la referencia, en respuesta al oficio No. 11881 notificado por fijación en lista el día 23 de septiembre de 2014, atentamente me permito presentar los siguientes documento:

1. Copia certificada de la solicitud de patente Estadounidense No. 14/021,287 del 9 de septiembre de 2013, de la cual se reivindicó prioridad en el trámite de la presente solicitud. Este documento está siendo presentado dentro del término legal correspondiente, esto es, 9 de enero de 2015, de conformidad con lo dispuesto en el artículo 10 de la Decisión 486 de la Comisión de la Comunidad Andina.
2. Documento en que consta la cesión de derechos de los inventores Jorge A. Basulto y Charles D. Payne a favor de la sociedad solicitante.

Habiendo dado cumplimiento al requerimiento de ese Despacho, solicito respetuosamente se continúe con el trámite de la presente solicitud.

Señor Director,

SILVANA MARIA LÓPEZ DÍAZ

C.C. 22.468.787 de Barranquilla

T.P. 147463 del CSJ

[notificaciones@clarkemodet.com.co](mailto:notificaciones@clarkemodet.com.co)

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 14-197868-00002-0000

Fecha: 2014-11-20 16:04:48 Dep. 2020 DIR.NUEVASCR.  
Tra. 2 PATENTES Eve: 1 REGDEPOSITO  
Act. 444 RESPUESTAREQUE Folios: 54

2

## A S S I G N M E N T

Pursuant to our obligation to Harnischfeger Technologies, Inc. (hereinafter referred to as "Assignee"), a Delaware corporation having its principal place of business at:

2751 Centerville Road, Suite 342  
Wilmington, Delaware 19808

and for other valuable and sufficient consideration, receipt whereof is hereby acknowledged, we:

Jorge A. Basulto  
310 S. Daffodil Court  
Oconomowoc, WI 53066

Charles D. Payne  
105 Gordon Court  
Mukwonago, WI 53149

confirm our obligation to and hereby sell, assign and convey, unto Assignee, its successors and assigns, our entire right, title and interest -

(1) in and to inventions described in a patent application titled "SYSTEM AND METHOD OF SYNCHRONIZING TIME BETWEEN MULTIPLE SYSTEMS" for which we filed United States Patent Application No. 14/021,287, (Atty. File No. 043020-9161-US00) (hereinafter the "U.S. utility patent application");

(2) in and to the U.S. utility patent application, in and to all other patent applications (including divisional, continuation, continuation-in-part, 35 U.S.C. §111(b) provisional, 35 U.S.C. §111(a), and reissue applications) based upon said inventions, and in and to the patent or patents to be granted thereon, to the full end of the term or terms for which said patent or patents may be granted;

(3) in and to all patent applications on said invention now or hereafter filed in countries foreign to the United States of America, and in and to any and all patents granted on said applications to the full end of the terms for which said patents may be granted; and

(4) under the International Convention in respect to the U.S. utility patent application and agree that any patent applications of any foreign countries which may be filed shall be filed in the name of our Assignee with a claim to priority based on the U.S. utility patent application.

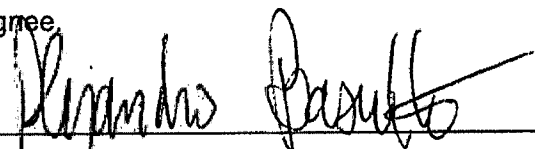
We hereby authorize the assignee or attorney of record to insert in the appropriate place in this document the application number of our application after execution of this Assignment. We hereby agree that we will, upon demand of Assignee, its successors or assigns, and without further consideration to us, execute any and all papers that may be necessary, or deemed by

Assignee, its successors or assigns, to be necessary, to a complete fulfillment of the intent and purposes of this Assignment, it being understood that any expense incident to the execution of such papers shall be paid by Assignee, its successors and assigns, and not by us.

The Commissioner of Patents and Trademarks of the United States is hereby authorized and requested to issue said patent or patents to Assignee.

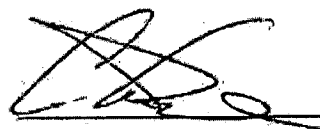
6 SEPT. 2013

Date

  
Jorge A. Basulto

6 SEPTEMBER 2013

Date

  
Charles D. Payne

STATE OF WISCONSIN     )  
                                      ) SS  
COUNTY OF MILWAUKEE    )

This is to certify that the attached is a true and correct copy of the Assignment recorded in the United States Patent & Trademark Office with respect to United States Patent Application Serial No. 14/021,287, filed September 9, 2013.

On this 5<sup>th</sup> day of November 2014

  
Name: Mary Crimmins  
[NOTARY PUBLIC]

My Commission Expires: October 14, 2017

## CESIÓN

De conformidad con nuestra obligación con Harnischfeger Technologies, Inc. (en lo sucesivo denominado como el "Cesionario"), una sociedad de Delaware que tiene su centro de actividad principal en:

2751 Centerville Road, Suite 342  
Wilmington, Delaware 19808

y por una consideración valiosa y suficiente, la cual reconocemos haber recibido, nosotros:

Jorge A. Basulto  
310 S. Daffodil Court  
Oconomowoc, WI 53066

Charles D. Payne  
105 Gordon Cort  
Mukwonago, WI 53149

confirmamos nuestra obligación y por este medio vendemos, cedemos y transferimos al Cesionario, sus sucesores y cesionarios, nuestro derecho, título e interés

(1) en y sobre las invenciones descritas en una solicitud de patente titulada "SISTEMA Y MÉTODO PARA SINCRONIZAR TIEMPO ENTRE SISTEMAS MÚLTIPLES" la cual presentamos bajo la solicitud de patente en Estados Unidos No. 14/021,287, (Expediente No. 043020-9161-US00) (en adelante, la "solicitud de patente de utilidad de E.U. ");

(2) en y sobre la solicitud de patente de utilidad de E.U., y para todas las demás solicitudes de patentes (incluyendo divisional, continuación, continuación en parte, 35 USC § 111 (b) provisional, 35 USC § 111 (a), y nuevas solicitudes) basadas en dichas invenciones, y en y para la patente o patentes que se concedan para la misma, hasta finalizar el término o términos para los cuales dicha patente o patentes puedan ser otorgadas;

(3) en y sobre todas las solicitudes de patente sobre dicha invención ahora o en el futuro presentadas en países extranjeros a los Estados Unidos de América, y en y sobre cualquier y todas las patentes concedidas en dichas solicitudes hasta finalizar el término o términos para los cuales dichas patentes puedan ser otorgadas; y

(4) en el marco del Convenio Internacional con respecto a la solicitud de patente de utilidad de E.U. y de acuerdo con cualquier solicitud de patente de cualquier país extranjero en el cual pueda eventualmente presentarse en el nombre de nuestro Cesionario reivindicando prioridad de la solicitud de patente de utilidad de E.U.

Por el presente autorizamos al cesionario o abogado registrar en el lugar apropiado en

este documento, el número de solicitud de nuestra solicitud, después de la ejecución de esta Cesión. Por el presente, acordamos por solicitud de la Cesionaria, sus sucesores o cesionarios, y sin mayor consideración, ejecutar cualquier y todos los documentos que sean necesarios, o que, a juicio del Cesionario, sus sucesores o cesionarios, sean necesarios, para completar y cumplir con los requisitos de la intención y el propósito de esta cesión, con el entendimiento de que cualquier incidente en gastos para la ejecución de dichos documentos será pagado por el Cesionario, sus sucesores y cesionarios, y no por nosotros.

El Comisionado de Patentes y Marcas de los Estados Unidos queda autorizado y solicitado para expedir dicha patente o patentes al Cesionario.

\_\_\_\_\_  
Fecha

\_\_\_\_\_  
(Firmado)  
Jorge A. Basulto

\_\_\_\_\_  
Fecha

\_\_\_\_\_  
(Firmado)  
Charles D. Payne

\_\_\_\_\_  
ESTADO DE WISCONSIN  
CONDADO DE MILWAUKEE

Certifica que el anexo es una copia fiel y exacta de la Cesión inscrita en la Oficina de Patentes y Marcas de Estados Unidos, en relación con la solicitud de patente de Estados Unidos No. 14/021,287, presentada el 9 de septiembre 2013.

5 de noviembre de 2014

\_\_\_\_\_  
(Firmado)  
Nombre: Mary Crimmins  
(NOTARIO PÚBLICO)

Mi comisión expira: 14 de octubre de 2017  
(Sello oficial del Notario Público)

ESTADOS UNIDOS DE AMERICA  
A TODOS AQUELLOS A QUIENES EL PRESENTE LLEGUE:

DEPARTAMENTO DE COMERCIO DE LOS ESTADOS UNIDOS  
Oficina de Patentes y Marcas de los Estados Unidos

3 de noviembre de 2014

La presente es para certificar que el anexo es una copia fiel de los registros de la Oficina de Patentes y Marcas de los Estados Unidos, de los documentos de la solicitud de patente identificada más adelante, que cumplieron con los requerimientos para concederse una fecha de presentación de acuerdo con 35 USC 111.

Número de Solicitud: **14/021,287**

Fecha de Presentación: **9 de septiembre de 2013**

EL CÓDIGO DEL PAÍS Y EL NÚMERO DE SU SOLICITUD DE PRIORIDAD, PARA SER USADA EN LA PRESENTACIÓN EXTRANJERA BAJO EL CONVENIO DE PARÍS ES **US 14/021,287**

Por la autoridad de

Bajo el Secretario de Comercio para la Propiedad Intelectual y el Director de la Oficina de Patentes y Marcas de los Estados Unidos de América

(fdo) **SYLVIA HOLLEY**

Oficial Certificador

(Sello oficial de la Oficina de Patentes y Marcas de los Estados Unidos de América)

## REIVINDICACIONES

Lo que se reivindica es:

1. Una máquina industrial que comprende:

un controlador lógico programable (PLC) que incluye un reloj de sistema PLC que tiene una hora local, la hora local es una hora de un área en la cual se ubica la máquina industrial, el área está por fuera de la zona horaria de la hora universal coordinada (UTC), el PLC operable para

controlar una función industrial de la máquina industrial, y

transmitir la hora local enmascarada como un valor de hora UTC; y

un subsistema de computadora que tiene un reloj de hora local con un parámetro de zona de hora configurable que se ajusta a la zona horaria UTC y un parámetro de Tiempo de Ahorro de Luz de Día (DST) que se deshabilita, el subsistema de computadora que recibe la hora local transmitida por el PLC y el reloj de la hora local se ajustan a la hora local recibida del PLC.

2. La máquina industrial de la reivindicación 1, que comprende además un suministro de energía primario que suministra energía a la máquina, en donde el PLC incluye además un paquete de batería que suministra energía de respaldo al reloj del sistema PLC cuando el suministro de energía primario está apagado.

3. La máquina industrial de la reivindicación 1, en donde el reloj del sistema PLC se ajusta a la hora local con base en al menos uno de un parámetro de ajuste de reloj del PLC, un parámetro DST del PLC, y un parámetro de zona horaria del PLC.

4. La máquina industrial de la reivindicación 3, que comprende además una computadora de mantenimiento, en donde al menos uno del parámetro de ajuste del reloj del PLC, el parámetro DST del PLC, y el parámetro de zona horaria del PLC se ajustan después de recibir una clave por la computadora de mantenimiento.

5. La máquina industrial de la reivindicación 4, en donde el reloj del sistema PLC se configura para actualizar con base en los ajustes hechos en al menos uno de los parámetros de ajuste del reloj del PLC, el parámetro DST del PLC, y el parámetro de zona horaria del PLC.

6. La máquina industrial de la reivindicación 1, que comprende además un receptor de actualización de hora configurado para recibir las actualizaciones de hora desde una fuente de hora remota utilizando un protocolo simple de tiempo de red (SNTP), en donde el receptor de actualización de hora se configura además para enviar las actualizaciones de hora al PLC.

7. La máquina industrial de la reivindicación 6, en donde el PLC calcula la hora local de la máquina industrial con base en la actualización de tiempo, un parámetro DST del PLC y un parámetro de zona horaria del PLC.

8. La máquina industrial de la reivindicación 1, en donde el sistema opera independiente de una fuente de hora remota.

9. La máquina industrial de la reivindicación 1, en donde la amnesia del DST se mitiga en la máquina industrial.

10. Un método para sincronizar la hora entre múltiples sistemas en una máquina industrial, el método comprende:

ajustar un reloj de sistema del controlador lógico programable (PLC) de un PLC a una hora local, la hora local es una hora de un área en la cual se ubica la máquina industrial, el área esta por fuera de la zona horaria de la Hora Universal Coordinada (UTC); ajustar un parámetro de zona horaria de un subsistema de computadora de la máquina industrial a la zona horaria UTC;

deshabilitar un parámetro de Tiempo de Ahorro de Luz de Día (DST) del subsistema de computadora para ignorar el DST;

recibir, mediante el PLC, una solicitud de actualización de hora UTC de un subsistema de computadora;

enviar un valor de hora corriente del reloj del sistema PLC al subsistema de computadora enmascarado como un valor de hora UTC en respuesta a recibir la solicitud de actualización de hora UTC; y

establecer un reloj de un subsistema de computadora a un valor de tiempo corriente del reloj del sistema PLC.

11. El método de la reivindicación 10, que comprende además:

establecer al menos un parámetro DST del PLC, un parámetro de ajuste de reloj del PLC, y un parámetro de zona horaria del PLC; y

calcular la hora local de la máquina industrial con base en al menos el parámetro DST del PLC, el parámetro de ajuste del reloj del PLC y el parámetro de zona horaria del PLC.

12. El método de la reivindicación 11, que comprende además actualizar el reloj del sistema PLC con base en los ajustes hechos por al menos uno del parámetro DST del PLC, el parámetro de ajuste del reloj del PLC, y el parámetro de zona horaria del PLC.

13. El método de la reivindicación 10, que comprende además actualizar el reloj del sistema PLC con base en la actualización de hora de una fuente de hora remota.

14. El método de la reivindicación 10, que comprende además:

recibir, en un receptor de actualización de hora, una actualización de hora de un servidor de protocolo simple de tiempo de red (SNTP); enviar la actualización de hora al PLC; y

calcular la hora local de la máquina industrial con base en la actualización de hora, un parámetro DST del PLC, y un parámetro de zona horaria del PLC.

15. El método de la reivindicación 10, que comprende además suministrar una energía de respaldo al reloj del sistema PLC mediante un paquete de batería cuando el suministro de energía primario de la máquina industrial está apagado.

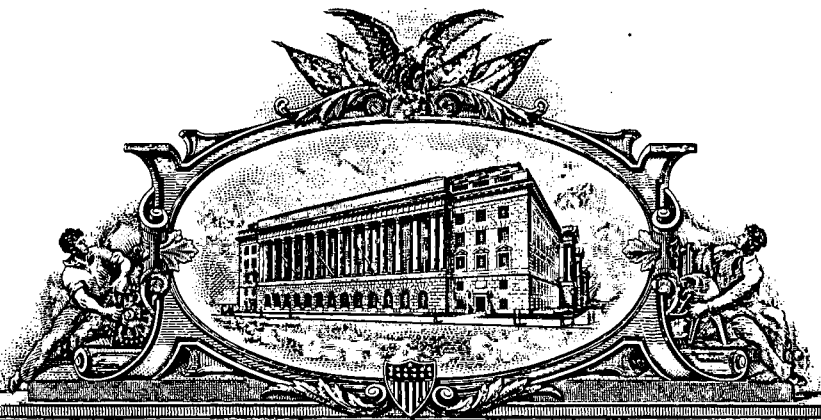
16. El método de la reivindicación 12, que comprende además:

recibir una clave, por la computadora de mantenimiento; y

después de confirmar la clave, recibir los ajustes en al menos uno de los parámetros DST del PLC, el parámetro de configuración del reloj del PLC, y el parámetro de zona horaria del PLC.

17. El método de la reivindicación 10, que comprende además ajustar y actualizar el reloj del sistema PLC independiente de una fuente de hora remota.

18. El método de la reivindicación 10, en donde la amnesia DST se mitiga en la máquina industrial.



# THE UNITED STATES OF AMERICA

**TO ALL TO WHOM THESE PRESENTS SHALL COME:**

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office

November 03, 2014

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

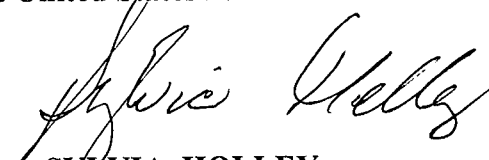
APPLICATION NUMBER: *14/021,287*

FILING DATE: *September 09, 2013*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS *US14/021,287*

By Authority of the  
Under Secretary of Commerce for Intellectual Property  
and Director of the United States Patent and Trademark Office



  
SYLVIA HOLLEY  
Certifying Officer

## Electronic Acknowledgement Receipt

|                                             |                                                                  |
|---------------------------------------------|------------------------------------------------------------------|
| <b>EFS ID:</b>                              | 16794483                                                         |
| <b>Application Number:</b>                  | 14021287                                                         |
| <b>International Application Number:</b>    |                                                                  |
| <b>Confirmation Number:</b>                 | 2699                                                             |
| <b>Title of Invention:</b>                  | SYSTEM AND METHOD OF SYNCHRONIZING TIME BETWEEN MULTIPLE SYSTEMS |
| <b>First Named Inventor/Applicant Name:</b> | Jorge A. Basulto                                                 |
| <b>Customer Number:</b>                     | 23409                                                            |
| <b>Filer:</b>                               | Kevin P. Rizzuto/Tanya Parent                                    |
| <b>Filer Authorized By:</b>                 | Kevin P. Rizzuto                                                 |
| <b>Attorney Docket Number:</b>              | 043020-9161-US00                                                 |
| <b>Receipt Date:</b>                        | 09-SEP-2013                                                      |
| <b>Filing Date:</b>                         |                                                                  |
| <b>Time Stamp:</b>                          | 15:04:25                                                         |
| <b>Application Type:</b>                    | Utility under 35 USC 111(a)                                      |

### Payment information:

|                                          |                 |
|------------------------------------------|-----------------|
| Submitted with Payment                   | yes             |
| Payment Type                             | Deposit Account |
| Payment was successfully received in RAM | \$1600          |
| RAM confirmation Number                  | 1613            |
| Deposit Account                          | 080757          |
| Authorized User                          |                 |

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

# File Listing:

| Document Number              | Document Description                                | File Name                                                         | File Size(Bytes)/<br>Message Digest                  | Multi Part /.zip | Pages (if appl.) |
|------------------------------|-----------------------------------------------------|-------------------------------------------------------------------|------------------------------------------------------|------------------|------------------|
| 1                            | Oath or Declaration filed                           | 13832288_043020-9161-US00_Executed_Declarations_-_as_filed.PDF    | 371881<br>675bb6c71c0c6d6395b10e96af1e9ca7d684c6     | no               | 2                |
| Warnings:                    |                                                     |                                                                   |                                                      |                  |                  |
| Information:                 |                                                     |                                                                   |                                                      |                  |                  |
| 2                            | Power of Attorney                                   | 13832542_043020-9161-US00_POA_-_as_filed.PDF                      | 782569<br>03db040d516d1b71401a438b11d1dc8b9ca801f62  | no               | 2                |
| Warnings:                    |                                                     |                                                                   |                                                      |                  |                  |
| Information:                 |                                                     |                                                                   |                                                      |                  |                  |
| 3                            | Application Data Sheet                              | 13832430_043020-9161-US00_ADS_-_as_filed.PDF                      | 1505306<br>e6fc8915b4f6976557e49c78572c1a58dedfde1ea | no               | 7                |
| Warnings:                    |                                                     |                                                                   |                                                      |                  |                  |
| Information:                 |                                                     |                                                                   |                                                      |                  |                  |
| 4                            |                                                     | 13832113_043020-9161-US00_Application_and_Drawings_-_as_filed.PDF | 362952<br>9d617Jdc218947309ffef7110ba86670dc2b2bf7   | yes              | 27               |
|                              | Multipart Description/PDF files in .zip description |                                                                   |                                                      |                  |                  |
|                              | Document Description                                |                                                                   | Start                                                | End              |                  |
|                              | Specification                                       |                                                                   | 1                                                    | 14               |                  |
|                              | Claims                                              |                                                                   | 15                                                   | 18               |                  |
|                              | Abstract                                            |                                                                   | 19                                                   | 19               |                  |
|                              | Drawings-only black and white line drawings         |                                                                   | 20                                                   | 27               |                  |
| Warnings:                    |                                                     |                                                                   |                                                      |                  |                  |
| Information:                 |                                                     |                                                                   |                                                      |                  |                  |
| 5                            | Fee Worksheet (SB06)                                | fee-info.pdf                                                      | 33519<br>5072e561bd490079aa6f9837251771B2c229c318    | no               | 2                |
| Warnings:                    |                                                     |                                                                   |                                                      |                  |                  |
| Information:                 |                                                     |                                                                   |                                                      |                  |                  |
| Total Files Size (in bytes): |                                                     |                                                                   | 3056227                                              |                  |                  |

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

**New Applications Under 35 U.S.C. 111**

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

**National Stage of an International Application under 35 U.S.C. 371**

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

**New International Application Filed with the USPTO as a Receiving Office**

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

## **SYSTEM AND METHOD OF SYNCHRONIZING TIME BETWEEN MULTIPLE SYSTEMS**

### **FIELD**

[0001] Embodiments of the invention relate to synchronizing time between multiple systems on a local area network.

### **BACKGROUND**

[0002] Various industrial machines, including mining machines, are used to meet tasks and challenges in industry today. For example, mining machines as used herein include, but are not limited to, shovels, hybrid shovels, blast hole drills, draglines, wheel loaders and dozers, conveyor systems, and feeder-breakers.

### **SUMMARY**

[0003] Industrial and mining machines have become more sophisticated and may include various hardware and software components to control and monitor the machines. Monitoring such machines may involve data collection across various systems and subsystems and may involve time stamping at both the system level and the subsystem level. In some systems, data loss and other issues occur from an inability to maintain proper settings for time zone and daylight savings on each subsystem of an industrial or mining machine.

[0004] In some embodiments, the invention provides systems and methods for synchronizing clocks of multiple systems on a machine in a manner designed to reduce or overcome problems with the prior art. For instance, subsystems of a machine synchronize their clocks to one source without having to rely on their own on-board subsystem parameters. Additionally, a programmable logic controller (PLC) on the machine serves as a master clock for subsystems of the machine. Thus, time zone parameters and Daylight Saving Time (DST) parameters only need to be updated on the PLC rather than on every subsystem of the machine. Furthermore, the parameters of the PLC are programmable rather than hard-coded. Thus, the parameters are easier to adjust.

[0005] The machine may also include a battery pack to allow the PLC's clock to remain operational for several months or longer to prevent DST problems caused by re-booting subsystems with out-of-date parameters. Thus, subsystems of the machine maintain accurate time stamps without synchronizing to a remote server and without making their own calculations using their own time zone and DST parameters. In some embodiments of the invention, an additional device receives time information from a remote time source and transmits the time information to the PLC. Additionally, embodiments of the invention eliminate Simple Network Time Protocol (SNTP) server stability and accuracy issues by treating the PLC as an SNTP server. In some instances, the PLC clock operates independent of external time sources and instead relies on its own internal clock and programmable parameters.

[0006] In one embodiment, the invention provides an industrial machine, such as a mining machine, comprising: a programmable logic controller (PLC) and a computer subsystem. The PLC includes a PLC system clock having a local time, the local time being a time of an area in which the industrial machine is located, the area being outside of the Coordinated Universal Time (UTC) time zone. The PLC is operable to control an industrial function of the industrial machine. For example, the PLC is operable to control mining functions of a mining machine, such as a digging, drilling, dumping, crushing, conveying function, etc., by receiving operator input and, in response, controlling shovels, drills, conveyors and/or other equipment of the mining machine. The PLC is also operable to transmit the local time masked as a UTC time value. The computer subsystem has a local time clock with a configurable time zone parameter that is set to the UTC time zone and a Daylight Saving Time (DST) parameter set to ignore DST. The computer subsystem receives the local time transmitted by the PLC, and the local time clock is set to the received local time from the PLC.

[0007] In another embodiment, the invention provides a method of synchronizing time between multiple systems on an industrial machine, such as a mining machine. The method includes setting a programmable logic controller (PLC) system clock of a PLC to a local time, the local time being a time of an area in which the industrial machine is located, the area being outside of the Coordinated Universal Time (UTC) time zone. The method further includes setting a time zone parameter of a computer subsystem of the industrial machine to the UTC time zone and setting a Daylight Saving Time (DST) parameter of the computer subsystem to ignore

DST. Thereafter, the PLC receives a UTC time update request from the computer subsystem. The method further includes sending a current time value of the PLC system clock to the computer subsystem masked as a UTC time value in response to receiving the UTC time update request; and setting a clock of the computer subsystem to the current time value of the PLC system clock.

[0008] Other aspects of the invention will become apparent by consideration of the detailed description and accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1A illustrates a mining shovel that may incorporate embodiments of the invention.

[0010] FIG. 1B illustrates a mining drill that may incorporate embodiments of the invention.

[0011] FIG. 2 illustrates a prior art system that uses Simple Network Time Protocol (SNTP) to synchronize the clocks of numerous subsystems on a mining machine.

[0012] FIG. 3 illustrates a block diagram of the prior art process executed by the system of FIG. 2 to synchronize the clocks of the subsystems of the mining machine.

[0013] FIG. 4 illustrates an improved time synchronization system on a mining machine.

[0014] FIG. 5 illustrates a programmable logic controller (PLC) of the system of FIG. 4.

[0015] FIG. 6 illustrates a system that synchronizes the clocks of numerous subsystems on a mining machine by using the PLC's clock as a master clock.

[0016] FIG. 7 illustrates a block diagram of the process executed by the system of FIG. 6 to synchronize the clocks of the subsystems of the mining machine.

#### DETAILED DESCRIPTION

[0017] Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the

arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phrasology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of "including," "comprising" or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. The terms "mounted," "connected" and "coupled" are used broadly and encompass both direct and indirect mounting, connecting and coupling. Further, "connected" and "coupled" are not restricted to physical or mechanical connections or couplings, and can include electrical connections or couplings, whether direct or indirect. Also, electronic communications and notifications may be performed using any known means including direct connections, wireless connections, etc.

[0018] It should also be noted that a plurality of hardware and software based devices, as well as a plurality of different structural components may be used to implement the invention. In addition, it should be understood that embodiments of the invention may include hardware, software, and electronic components or modules that, for purposes of discussion, may be illustrated and described as if the majority of the components were implemented solely in hardware. However, one of ordinary skill in the art, and based on a reading of this detailed description, would recognize that, in at least one embodiment, the electronic based aspects of the invention may be implemented in software (*e.g.*, stored on non-transitory computer-readable medium) executable by one or more processors. As such, it should be noted that a plurality of hardware and software based devices, as well as a plurality of different structural components may be utilized to implement the invention. Furthermore, and as described in subsequent paragraphs, the specific mechanical configurations illustrated in the drawings are intended to exemplify embodiments of the invention and that other alternative mechanical configurations are possible. For example, "controllers" described in the specification can include standard processing components, such as one or more processors, one or more computer-readable medium modules, one or more input/output interfaces, and various connections (*e.g.*, a system bus) connecting the components.

[0019] Fig. 1A illustrates an electric mining rope shovel 100, herein referred to as shovel 100. The shovel 100 includes tracks 105 for propelling the shovel 100 forward and backward,

and for turning the shovel 100 (i.e., by varying the speed and/or direction of the left and right tracks relative to each other). The tracks 105 support a base 110 including a cab 115. The base 110 is able to swing or swivel about a swing axis 125, for instance, to move from a digging location to a dumping location. Movement of the tracks 105 is not necessary for the swing motion. The shovel 100 further includes a dipper shaft 130 supporting a pivotable dipper handle 135 (handle 135) and dipper 140. The dipper 140 includes a door 145 for dumping contents from within the dipper 140 into a dump location, such as a hopper or dump-truck.

[0020] The shovel 100 also includes taut suspension cables 150 coupled between the base 110 and dipper shaft 130 for supporting the dipper shaft 130; a hoist cable 155 attached to a winch (not shown) within the base 110 for winding the cable 155 to raise and lower the dipper 140; and a dipper door cable 160 attached to another winch (not shown) for opening the door 145 of the dipper 140. In some instances, the shovel 100 is a P&H<sup>®</sup> 4100 series shovel produced by P&H Mining Equipment Inc., although the shovel 100 can be another type or model of electric mining equipment.

[0021] Fig. 1B illustrates an electric mining drill 170 (the "drill 170"). In some embodiments, the drill 170 is a blast hole drill, such as a 320 XPC drill or another Centurion<sup>®</sup>-based drill manufactured by Job Global, Inc.

[0022] The drill 170 includes tracks 172 for propelling the drill 170 forward and backward, and for turning the drill 170 (i.e., by varying the speed and/or direction of the left and right tracks relative to each other). The tracks 172 support a platform 174 including a cab 176 and a mast 178. The platform 174 includes four jacks 180 that may be selectively raised and lowered via a hydraulic system. When lowered and set, the four jacks 180 prevent movement of the drill 170 for drilling. The mast 178 supports a drill bit 182 that is rotationally driven and selectively raised and lowered to bore into an area below the platform 174.

[0023] FIG. 2 illustrates a prior art system 200 located on a machine 205 such as the shovel 100 or the drill 170. The subsystems of the machine 205 include, for instance, a programmable logic controller (PLC) 210, a data logger 215, and a data source 220 (e.g., a sensor).

[0024] In the prior art system shown in Fig. 2, the PLC 210 is connected to at least one other subsystem on the machine 205 and includes software that makes control decisions for operation of the machine 205. The data logger 215 is connected to at least one other subsystem on the machine 205 and aggregates data collected by data source 220 and additional subsystems (not pictured). The subsystems are connected to each other using a local area network (LAN) (not pictured). The PLC 210 includes a PLC clock 225. Data logger 215 includes a data logger clock 230, and data source 220 includes a data source clock 235. The subsystem clocks can be used to time stamp data.

[0025] Each subsystem also includes its own time zone parameter and Daylight Saving Time (DST) parameter. The PLC 215 includes a PLC time zone parameter 212 and a PLC DST parameter 213. The data logger 215 includes a data logger time zone parameter 217 and a data logger DST parameter 218. The data source 220 includes a data source time zone parameter 222 and a data source DST parameter 223.

[0026] The data logger 215 receives data that was time stamped by the subsystem that collected the data. Additionally, the data logger 215 time stamps data when data is received. The data logger 215 can compare its own time stamp with the time stamp generated by the subsystem. If the time stamps are not within a specified range, the data is assumed to be corrupt and is discarded. Furthermore, the data logger 215 can compare the time stamps for data generated by multiple subsystems in order to synchronize data collected from multiple sources on the machine 205.

[0027] The system 200 uses Simple Network Time Protocol (SNTP) to synchronize the clocks of the numerous subsystems of the machine 205. SNTP utilizes a server-client relationship where SNTP clients periodically request time updates from an SNTP server. An SNTP server 240 is located remotely from the machine 205 and often is located in a different time zone and/or country than the machine 205. The SNTP server 240 includes a SNTP server clock 245, a SNTP server time zone parameter 246, and a SNTP server Daylight Saving Time (DST) parameter 247. The SNTP server 240 takes a local time from the SNTP server clock 245 and calculates Coordinated Universal Time (UTC) value 250 using time zone parameter 246 and

DST parameter 247. The SNTP server 240 can then transmit UTC value 250 to requesting subsystems.

[0028] In general, UTC is a time standard that is used to regulate clocks and time. The UTC value represents the time in the UTC time zone, which includes Greenwich, England. When clocks or systems receive a UTC value, the UTC value is adjusted using local DST and time zone information. For example, a device located in a time zone five hours ahead of the UTC time zone would add five hours to the received UTC value. In a similar manner, devices providing UTC values (i.e., SNTP servers) perform a reverse calculation. For example, a device located in a time zone five hours ahead of the UTC time zone would subtract five hours from its local time and then send the UTC value to a requesting device.

[0029] FIG. 3 illustrates a block diagram of the prior art process executed by the system 200 of FIG. 2 to synchronize the clocks of the subsystems of the machine 205. Each subsystem of the machine 205 acts as an SNTP client and periodically requests time updates from an SNTP server 240 (step 305). Upon receiving a time update request, the SNTP server 240 calculates UTC value 250 based on its local time from the SNTP server clock in combination with the SNTP server time zone parameter 246 and the SNTP server DST parameter 247 (step 310). The SNTP server 240 then transmits the UTC value 250 back to the subsystem that requested the time update (step 315). Each subsystem must use its own hard-coded, on-board time zone parameters and DST parameters to calculate its local time (step 320). Each subsystem runs its clock according to the calculated updated local time (325).

[0030] According to the time synchronization system and method utilized in FIGS. 2 and 3, the SNTP server 240 serves as the master clock for the system 200, meaning that other clocks in the system 200 synchronize based on information received from the SNTP server 240. Even though the SNTP server 240 is the master clock, each subsystem must calculate its own local time to use for its own clock. Thus, time synchronization between subsystems is prevented if the on-board parameters for each subsystem are not up-to-date and consistent with other subsystems on the machine 205.

[0031] Accordingly, SNTP has shortcomings when applied to a small LAN where devices do not have continuous access to the Internet, such as the small LAN that can be used on mining

machines or other industrial machines. SNTP depends on each client having up-to-date parameters for when a particular time zone begins and ends DST. However, the current time zone and applicable DST rules for a particular machine 205 can change due to movement of the machine 205 or alterations in DST rules by different governing bodies.

[0032] Furthermore, subsystems may use an operating system that cannot be changed or configured by a user, or they may have time zone and DST parameters that are hard-coded. Thus, subsystem parameters can be difficult to adjust or cannot be adjusted at all. Additionally, the subsystems do not continue to function when the machine 205 is turned off. Even when updates are made to subsystem parameters, subsystems cannot retain knowledge that the update was made once they are turned off. Accordingly, each time the machine 205 is powered on, subsystems may use outdated DST information to add or subtract an hour even though the subsystems were previously updated. This issue has been referred to as "DST Amnesia."

[0033] Furthermore, SNTP service software periodically has stability problems. If the SNTP server stops operating, subsystems acting as SNTP clients are unable to synchronize their clocks. Additionally, some SNTP servers have accuracy issues due to different central processing unit (CPU) chips. Some SNTP servers can lose time at a rate of almost one second per minute. This inaccuracy is unacceptable for subsystems of machines that require accurate time synchronization. Consequently, the system and method shown in FIGS. 2 and 3 do not adequately ensure that clocks on the subsystems of a mining machine are accurate and consistent.

[0034] FIG. 4 illustrates an improved time synchronization system 400 for use on machine 403, such as the shovel 100, the drill 170, a hybrid shovel, dragline, wheel loaders and dozers, conveyor systems, feeder-breakers, or another mining or industrial machine. The subsystems of the machine 403 can communicate with each other via an Ethernet LAN 405. The subsystems of the machine 403 include a programmable logic controller (PLC) 410, a data logger 415, a data source 420 (e.g., a sensor), a maintenance computer 425, a machine operator computer 430, and a time update receiver 435. The PLC 410 includes software that makes control decisions for operation of the machine 403 (e.g., based on operator commands, stored parameters, sensor data, etc.). The data logger 415 aggregates data collected by data source 420 and additional

subsystems. The maintenance computer 425 allows qualified maintenance personnel to make adjustments to the system 400. The machine operator computer 430 allows an operator to control the machine 403.

[0035] The system 400 is capable of receiving time updates on a time update receiver 435 from a remote time source 440. However, in some embodiments, the system 400 functions without receiving time updates from a remote time source 440. The system 400 further includes a primary power supply 445. Primary power supply 445 provides power to the subsystems of machine 403 to allow it to function. Although certain subsystems are pictured in FIG. 4, the machine 403 can include additional subsystems that serve various purposes. Additional subsystems may include sensors and/or devices that measure and/or determine torque, weight, vibration, temperature, motor position, speed, acceleration, fluid levels, pressure, flow rates, and whether solenoids are enabled.

[0036] FIG. 5 illustrates the PLC 410 of system 400. The PLC 410 includes a PLC system clock 505, a clock setting parameter 510, a Daylight Saving Time (DST) parameter 520, and a time zone parameter 522. The PLC system clock 505 may include a combination of hardware and software used in conjunction with a crystal oscillator to keep time. The clock setting parameter 510 allows qualified maintenance personnel to set and adjust the PLC system clock 505. For example, qualified maintenance personnel can enter a local time (e.g., 3:45 p.m.) into clock setting parameter 510 and the PLC system clock 505 will run according to the entered time. DST parameter 520 and time zone parameter 522 can be used to calculate a local time of the machine 403 when the PLC 410 receives a time update from the time update receiver 435. For example, if the PLC 410 receives a Coordinated Universal Time (UTC) value, parameters 520 and 522 can be used to calculate the local time of the machine 403. Additionally, DST parameter 520 can be used to update the PLC system clock 505 properly when DST is in effect. Thus, DST parameter 520 can adjust the PLC system clock 505 without the PLC 410 receiving time updates as well as in embodiments where the remote time source 440 is not used.

[0037] The PLC 410 also includes a rechargeable battery pack 525 to allow the PLC system clock 505 to continue running for several months or longer even when the primary power supply 445 of machine 403 is unavailable or turned off. Accordingly, the rechargeable battery pack 525

provides backup power to the PLC. In some embodiments, the rechargeable battery pack 525 is located external to the PLC 410 and can provide backup power to other subsystems. In embodiments that use a remote time source 440 to update the PLC system clock 505, the rechargeable battery pack 525 may allow for parameters 520 and 522 to be maintained in memory when primary power supply 445 is unavailable or off. Alternatively, the parameters 520 and 522 may be stored in a nonvolatile memory.

[0038] FIG. 6 illustrates a more detailed diagram of the system 400 that synchronizes the clocks of numerous subsystems on a machine 403 by using the PLC system clock 505 as a master clock. Data logger 415 includes a data logger clock 630. Data source 420 includes a data source clock 635. The clocks 630 and 635 of the subsystems can be used to time stamp data.

[0039] Each subsystem also includes its own time zone parameter and DST parameter. The data logger 415 includes a data logger time zone parameter 617 and a data logger DST parameter 618. The data source 420 includes a data source time zone parameter 622 and a data source DST parameter 623. The maintenance computer 425 and machine operator computer 430 of system 400 are not pictured in FIG. 6 but have similar configurations as those of data logger 415 and data source 420.

[0040] The DST parameters can include a DST setting parameter and a DST on/off parameter. The DST setting parameter is a binary parameter that is set to either standard time (e.g., during winter months) or daylight saving time (e.g., during summer months). The DST on/off parameter controls whether the DST setting parameter influences calculations of local time. Stated another way, the DST on/off parameter controls whether a subsystem uses its DST setting parameter to calculate local time. Thus, the DST on/off parameter enables or disables the DST setting parameter, while the DST setting parameter indicates whether a DST offset is taken into account in local time calculations based on the current time of year. Accordingly, a DST parameter may be effectively disabled or ignored in time calculations by either setting the DST on/off parameter to "off" or, when the DST on/off parameter is "on," by setting the DST setting parameter to standard time, rather than DST time.

[0041] The data logger 415 receives data that was time stamped by the subsystem that collected the data. Additionally, the data logger 415 time stamps data when data is received.

The data logger 415 can compare its own time stamp with the time stamp generated by the subsystem. If the time stamps are not within a specified range, the data is assumed to be corrupt and is discarded. Furthermore, the data logger 415 can compare the time stamps for data generated by multiple subsystems in order to synchronize data collected from multiple sources on the machine 403. Thus, synchronization of subsystem clocks on the machine enables accurate data collections and prevents data from being discarded.

[0042] The system 400 reduces and may eliminate loss of data due to lack of time synchronization between subsystems on the machine 403. The system 400 uses the PLC system clock 505 as the master clock for subsystems on the machine 403.

[0043] The subsystems of machine 403 are Simple Network Time Protocol (SNTP) clients that periodically request time updates, which are handled by software on the PLC 410. SNTP clients expect to receive a UTC value in response to their time update requests. However, the PLC 410 responds to time update requests by sending the local time of the machine 403. Thus, the local time is masked as the UTC value. Stated another way, the SNTP clients periodically request UTC time, and receive a local time of the PLC 410 masked as the UTC time.

[0044] Accordingly, the time zone parameters of each subsystem, including time zone parameters 617 and 622, assume that the machine 403 is in the UTC time zone even though the machine is not located in the UTC time zone. That is, the time zone parameters are set to the UTC time zone. Thus, when subsystems receive updated times from the PLC 410 after requesting a time update, the time received will not be adjusted based on the time zone parameters 617 and 622. Additionally, the DST parameters 618 and 623 of each subsystem are disabled such that DST is ignored. Thus, the time received by each subsystem from the PLC 410 will not be adjusted based on the DST parameters 618 and 622. Accordingly, the time received by each subsystem from the PLC 410 is not adjusted by that subsystem and will become the local time of each subsystem.

[0045] In some embodiments, remote time source 440 provides a time that the PLC 410 can use to synchronize its clock. Remote time source 440 is a SNTP server with a clock 604, a time zone parameter 605, and a DST parameter 606. The clock 604 keeps the local time of the remote time source 440. Parameters 605 and 606 are used to calculate UTC value 610 based on the

local time provided by the clock 604. Alternatively, remote time source 440 is another type of remote time source that does not use SNTP. In some instances the PLC 410 sends a time update request to the remote time source 440 (e.g., periodically), and the remote time source 440 sends a time (e.g., UTC time) to the time update receiver 435. Alternatively, the remote time source 435 may periodically send time updates to the time update receiver 435 without receiving a time update request from the PLC 410. In some embodiments, the PLC clock 505 cannot update its time from a remote time source 440. Rather, the PLC clock 505 is set initially and updated as needed via the maintenance computer 425. In some embodiments, the time update receiver is part of the PLC 410 and/or located within the PLC 410.

[0046] The system 400 enables the local time of subsystems to be adjusted by altering the clock setting parameter 510 and/or DST parameter 520 on the PLC 410. The individual settings of each subsystem do not need to be altered to update the local time of each subsystem. Furthermore, even if the settings on the PLC 410 are incorrect (due to recent time zone or DST changes), subsystems on the machine 403 will remain synchronized with each other. Thus, data is not lost due to inconsistent time stamps.

[0047] Additionally, the system 400 eliminates DST errors made by subsystems due to inability to retain knowledge that DST parameters were already updated. Subsystems do not add or subtract an hour each time they reboot because the DST parameters 618 and 623 of each subsystem are disabled such that DST is ignored. Furthermore, using the PLC system clock 505 as the synchronization source for subsystems instead of a SNTP server eliminates SNTP server functionality and accuracy issues. The behavior of the PLC system clock 505 is more accurate and more easily controlled than typical SNTP servers.

[0048] FIG. 7 illustrates a block diagram of a process 700 executed by system 400 to synchronize the clocks of the subsystems of machine 403. At step 705, qualified maintenance personnel can enter a password to gain access to adjust parameters of the system 400. After gaining access, the qualified maintenance personnel can input the clock setting parameter 510, DST parameter 520, and time zone parameter 522 of the PLC 410 (step 710). The system 400 calculates the local time of the machine 403 based on the entered parameters 510 and 520 (step 715). The PLC system clock 505 is set to the calculated local time. In some instances, such as

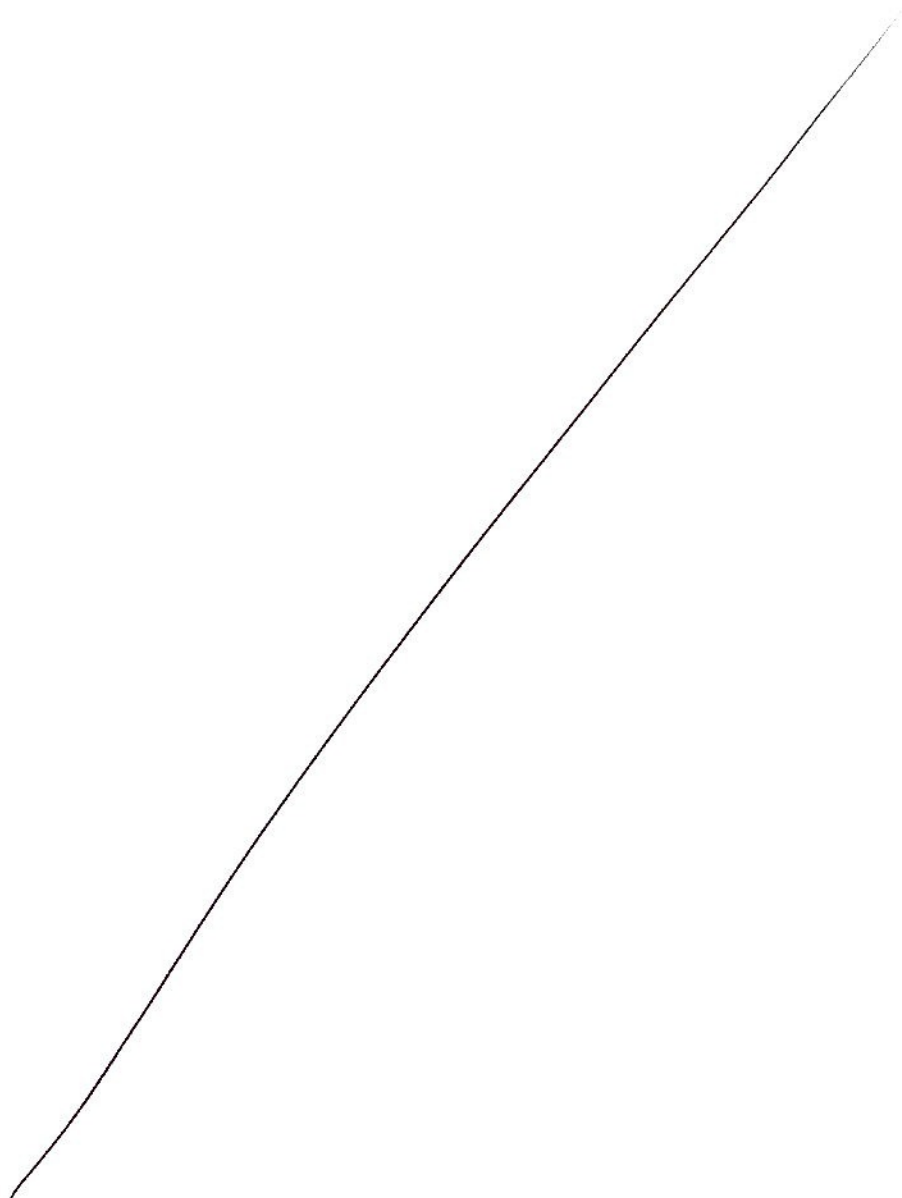
when the parameters are initially entered, the system 400 does not make calculations at step 715 and instead sets the PLC system clock 505 to the local time that was entered as the clock setting parameter 510. The PLC system clock 505 continuously runs and awaits time update requests from subsystems (step 720). The PLC system clock acts as the SNTP server for the subsystems of the machine 403. If the PLC 410 receives a time update request (i.e., a UTC time request) from one or more subsystems (step 722), the PLC sends the current PLC system clock to the requesting subsystem(s) masked as a UTC time (step 723).

[0049] If a time update is available from a remote time source (step 725), a time update receiver 435 receives the time update (step 730). In some embodiments the time update is received using SNTP from an SNTP server, and the time update receiver 435 sends the time update to the PLC 410 using a second communication protocol (step 735). The PLC 410 then calculates the updated time for the PLC system clock 505 using the time update, the PLC DST parameter 520, and the PLC time zone parameter 522 (step 737). In some embodiments, the remote time source 440 is an SNTP server. In alternate embodiments, the remote time source 440 does not utilize SNTP. In some embodiments, the PLC system clock 505 runs based on the parameters 510 and 520 and a locally provided time, and is configured not to update from a remote time source 440. Stated another way, the PLC system clock 505 runs independent of a remote time source 440.

[0050] If qualified maintenance personnel alter the parameters 510 and 520 of the system 400 (step 740), the system 400 adjusts the PLC system clock 505 using the updated parameters 510 and 520 (step 715). Thus, the clocks of the subsystems on the machine 403 can be updated by altering the parameters 510 and 520 of the PLC 410.

[0051] Thus, embodiments of the invention provide, among other things, systems and methods for synchronizing time between multiple systems on an industrial machine, such as a mining machine. The systems and methods utilize a PLC system clock as a master clock for subsystems on the machine. Thus, the systems and methods allow for changes in time zone and DST information for subsystems on the machine to be easily adjusted from a single source (e.g., the PLC). The systems and methods further ensure that the various clocks on the machine are synchronized even if time zone and/or DST parameters of the PLC are not up-to-date.

[0052] Various features of the invention are set forth in the following claims.



## CLAIMS

What is claimed is:

1. An industrial machine comprising:

a programmable logic controller (PLC) including a PLC system clock having a local time, the local time being a time of an area in which the industrial machine is located, the area being outside of the Coordinated Universal Time (UTC) time zone, the PLC operable to

control an industrial function of the industrial machine, and

transmit the local time masked as a UTC time value; and

a computer subsystem having a local time clock with a configurable time zone parameter that is set to the UTC time zone and a Daylight Saving Time (DST) parameter that is disabled, the computer subsystem receiving the local time transmitted by the PLC and the local time clock being set to the received local time from the PLC.

2. The industrial machine of claim 1, further comprising a primary power supply that provides power to the machine, wherein the PLC further includes a battery pack providing backup power to the PLC system clock when the primary power supply is off.

3. The industrial machine of claim 1, wherein the PLC system clock is set to the local time based on at least one of a clock setting parameter of the PLC, a DST parameter of the PLC, and a time zone parameter of the PLC.

4. The industrial machine of claim 3, further comprising a maintenance computer, wherein at least one of the clock setting parameter of the PLC, the DST parameter of the PLC, and the time zone parameter of the PLC are adjusted after receiving a password by the maintenance computer.

5. The industrial machine of claim 4, wherein the PLC system clock is configured to update based on adjustments made to at least one of the clock setting parameter of the PLC, the DST parameter of the PLC, and the time zone parameter of the PLC.

6. The industrial machine of claim 1, further comprising a time update receiver configured to receive time updates from a remote time source using Simple Network Time Protocol (SNTP), wherein the time update receiver is further configured to send the time updates to the PLC.
7. The industrial machine of claim 6, wherein the PLC calculates the local time of the industrial machine based on the time update, a DST parameter of the PLC and a time zone parameter of the PLC.
8. The industrial machine of claim 1, wherein the system operates independent of a remote time source.
9. The industrial machine of claim 1, wherein DST amnesia is mitigated on the industrial machine..
10. A method of synchronizing time between multiple systems on an industrial machine, the method comprising:

setting a programmable logic controller (PLC) system clock of a PLC to a local time, the local time being a time of an area in which the industrial machine is located, the area being outside of the Coordinated Universal Time (UTC) time zone;

setting a time zone parameter of a computer subsystem of the industrial machine to the UTC time zone;

disabling a Daylight Saving Time (DST) parameter of the computer subsystem to ignore DST;

receiving, by the PLC, a UTC time update request from the computer subsystem;

sending a current time value of the PLC system clock to the computer subsystem masked as a UTC time value in response to receiving the UTC time update request; and

setting a clock of the computer subsystem to the current time value of the PLC system clock.

11. The method of claim 10, further comprising:

setting at least one of a DST parameter of the PLC, a clock setting parameter of the PLC, and a time zone parameter of the PLC; and

calculating the local time of the industrial machine based on at least one of the DST parameter of the PLC, the clock setting parameter of the PLC, and the time zone parameter of the PLC.

12. The method of claim 11, further comprising updating the PLC system clock based on adjustments made to at least one of the DST parameter of the PLC, the clock setting parameter of the PLC, and the time zone parameter of the PLC.

13. The method of claim 10, further comprising updating the PLC system clock based on a time update from a remote time source.

14. The method of claim 10, further comprising:

receiving, at a time update receiver, a time update from a Simple Network Time Protocol (SNTP) server;

sending the time update to the PLC; and

calculating the local time of the industrial machine based on the time update, a DST parameter of the PLC, and a time zone parameter of the PLC.

15. The method of claim 10, further comprising providing backup power to the PLC system clock by a battery pack when a primary power supply of the industrial machine is off.

16. The method of claim 12, further comprising:

receiving a password, by a maintenance computer; and

after confirming the password, receiving adjustments to at least one of the DST parameter of the PLC, the clock setting parameter of the PLC, and the time zone parameter of the PLC.

17. The method of claim 10, further comprising setting and updating the PLC system clock independent of a remote time source.
18. The method of claim 10, wherein DST amnesia is mitigated on the industrial machine.

ABSTRACT

Systems and methods for synchronizing time between multiple systems on a mining machine. The system includes a programmable logic controller (PLC) for controlling the mining machine and for transmitting a time to synchronize computer subsystems on the machine. The PLC includes a system clock that is programmed to operate on local time. A battery pack is connected to the PLC to allow the system clock to function continuously, even when the machine is turned off. Computer subsystems request and receive time updates from the PLC. A local time on each computer subsystem is determined based on the time update received from the PLC. Each computer subsystem includes a time zone parameter set to Coordinated Universal Time (UTC) and a Daylight Saving Time (DST) parameter that is disabled. Accordingly, the local time on each computer subsystem is set to the time update value received from the PLC.

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# DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

|                    |                                                                  |
|--------------------|------------------------------------------------------------------|
| Title of Invention | SYSTEM AND METHOD OF SYNCHRONIZING TIME BETWEEN MULTIPLE SYSTEMS |
|--------------------|------------------------------------------------------------------|

As the below named inventor, I hereby declare that:

This declaration is directed to: ☒ The attached application, or ☐ United States application or PCT international application number \_\_\_\_\_ filed on \_\_\_\_\_

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I have reviewed and understand the contents of the above identified application, including the claims.

I acknowledge the duty to disclose to the United States Patent & Trademark Office all information known to me to be material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

**WARNING:**

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identify theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, this record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: George A. Beaulieu Date (Optional): 6 SEPT 2013

Signature: [Handwritten Signature]

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/AI/01 form for each additional inventor.

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN  
APPLICATION DATA SHEET (37 CFR 1.76)**

Title of Invention: **SYSTEM AND METHOD OF SYNCHRONIZING TIME BETWEEN MULTIPLE SYSTEMS**

As the below named inventor, I hereby declare that:

This declaration is directed to: ☒ The attached application, or  
☐ United States application or PCT international application number \_\_\_\_\_  
 filed on \_\_\_\_\_.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I have reviewed and understand the contents of the above identified application, including the claims.

I acknowledge the duty to disclose to the United States Patent & Trademark Office all information known to me to be material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

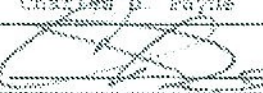
**WARNING:**

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

**LEGAL NAME OF INVENTOR**

Inventor: Charles B. Payne

Date (Optional): 6 SEPTEMBER 2013

Signature: 

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/AIA/S1 form for each additional inventor.

37

## TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA/82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

|                        |                                                                  |
|------------------------|------------------------------------------------------------------|
| Application Number     |                                                                  |
| Filing Date            | September 9, 2013                                                |
| First Named Inventor   | Jorge A. Basulto                                                 |
| Title                  | SYSTEM AND METHOD OF SYNCHRONIZING TIME BETWEEN MULTIPLE SYSTEMS |
| Art Unit               |                                                                  |
| Examiner Name          |                                                                  |
| Attorney Docket Number | 043020-9161-US00                                                 |

### SIGNATURE of Applicant or Patent Practitioner

|                                                    |                    |                     |                   |
|----------------------------------------------------|--------------------|---------------------|-------------------|
| Signature                                          | /kevin p. rizzuto/ | Date (Optional)     | September 9, 2013 |
| Name                                               | Kevin P. Rizzuto   | Registration Number | 59229             |
| Title (if Applicant is a juristic entity)          |                    |                     |                   |
| Applicant Name (if Applicant is a juristic entity) |                    |                     |                   |

**NOTE:** This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.



\*Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. 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 1.11 and 1.14. This collection is estimated to take 3 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, 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.**

*If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.*

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.

**POWER OF ATTORNEY BY APPLICANT**

I hereby revoke all previous powers of attorney given in the application identified in the attached transmittal letter.

- ☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent):

23409

OR

- ☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent):

| Name | Registration Number | Name | Registration Number |
|------|---------------------|------|---------------------|
|      |                     |      |                     |
|      |                     |      |                     |
|      |                     |      |                     |
|      |                     |      |                     |
|      |                     |      |                     |
|      |                     |      |                     |

Please recognize or change the correspondence address for the application identified in the attached transmittal letter to:

- ☒ The address associated with the above-mentioned Customer Number.

OR

- ☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name

Address

City

State

Zip

Country

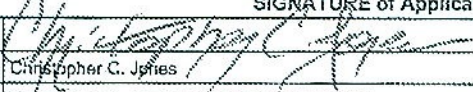
Telephone

Email

I am the Applicant:

- ☐ Inventor or Joint Inventor
- ☐ Legal Representative of a Deceased or Legally Incapacitated Inventor
- ☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign
- ☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document)

**SIGNATURE of Applicant for Patent**

|                   |                                                                                     |           |                    |
|-------------------|-------------------------------------------------------------------------------------|-----------|--------------------|
| Signature         |  | Date      | September 20, 2012 |
| Name              | Christopher C. Jiles                                                                | Telephone | 302.225.5810       |
| Title and Company | Vice President, Hamischfeger Technologies, Inc.                                     |           |                    |

**NOTE:** Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms for more than one signature, see below \*.

☒ \*Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. 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 1.11 and 1.14. This collection is estimated to take 3 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, 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.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

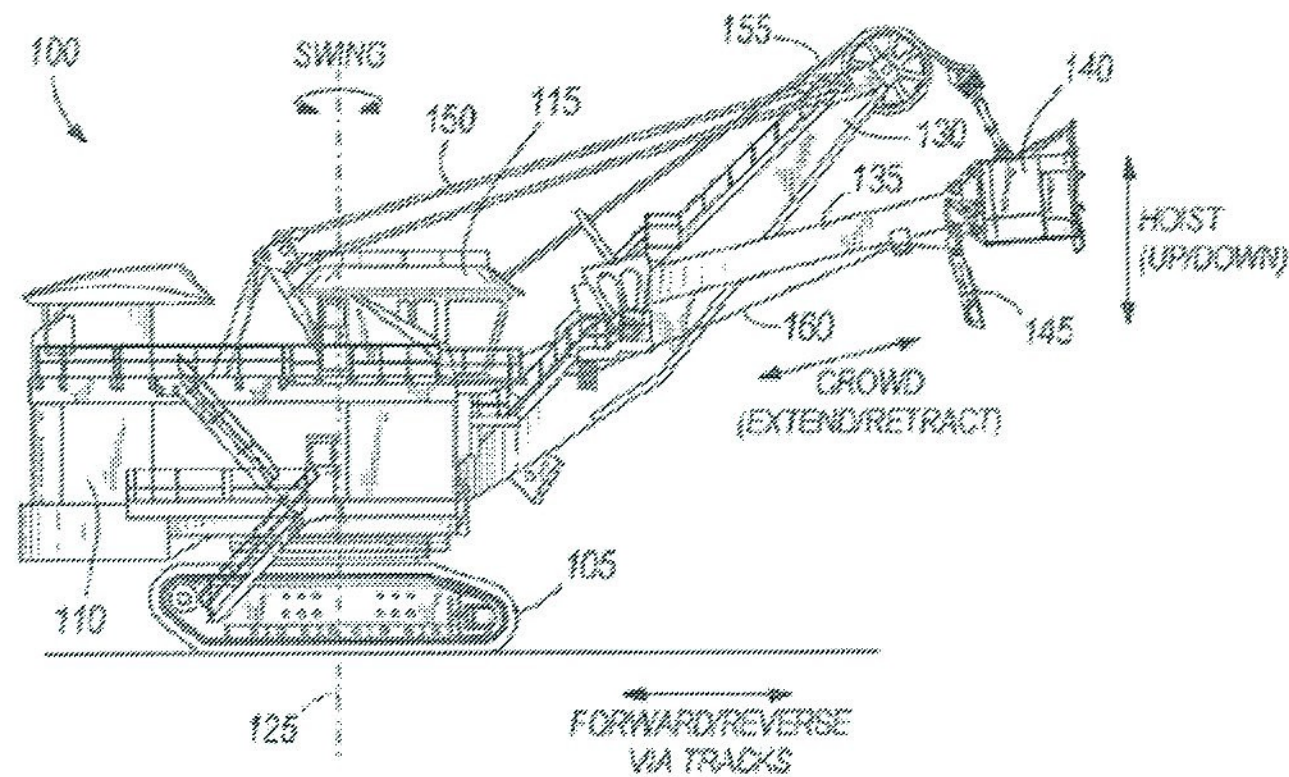


Fig. 1A

41

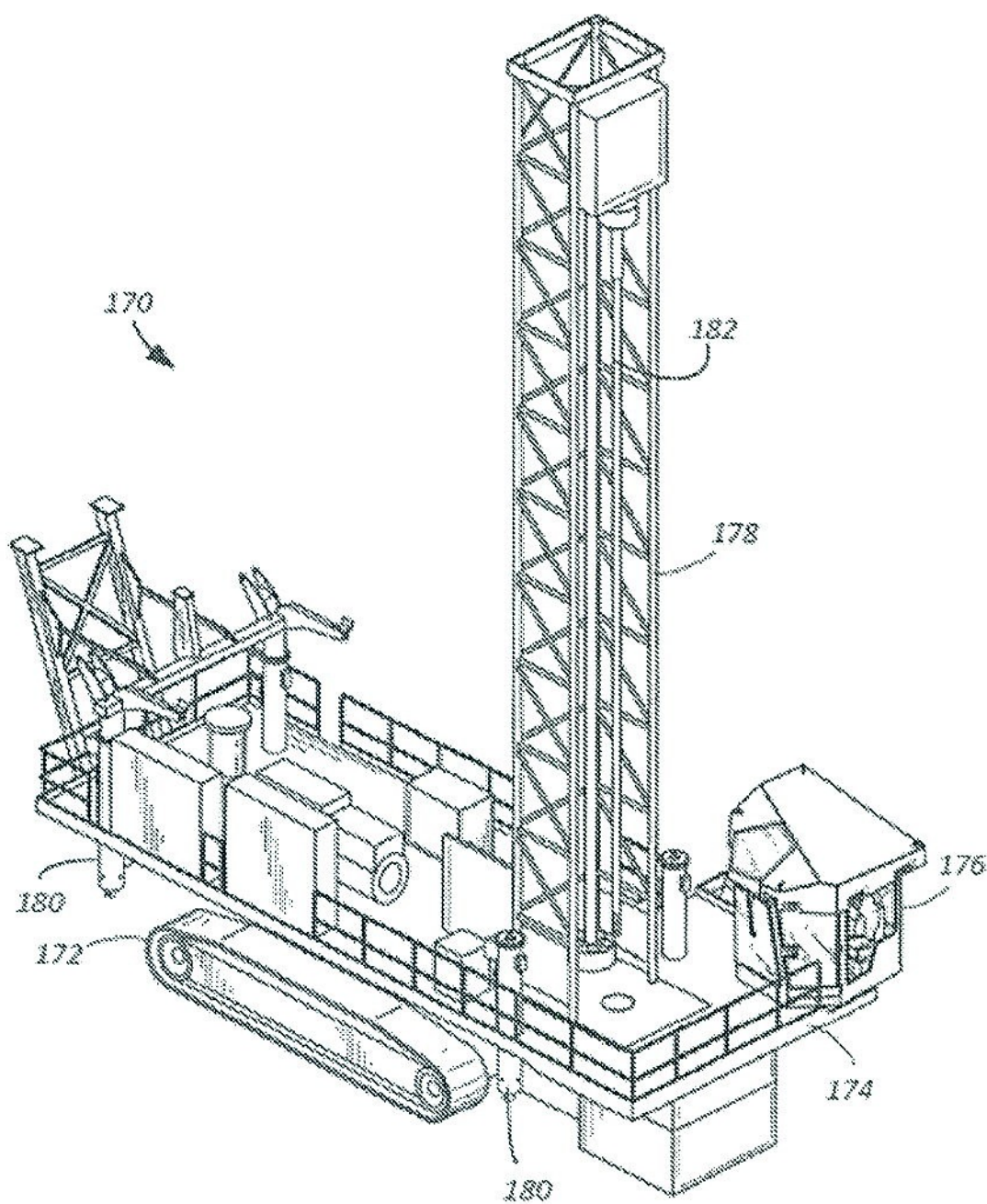


Fig. 1B

40

42

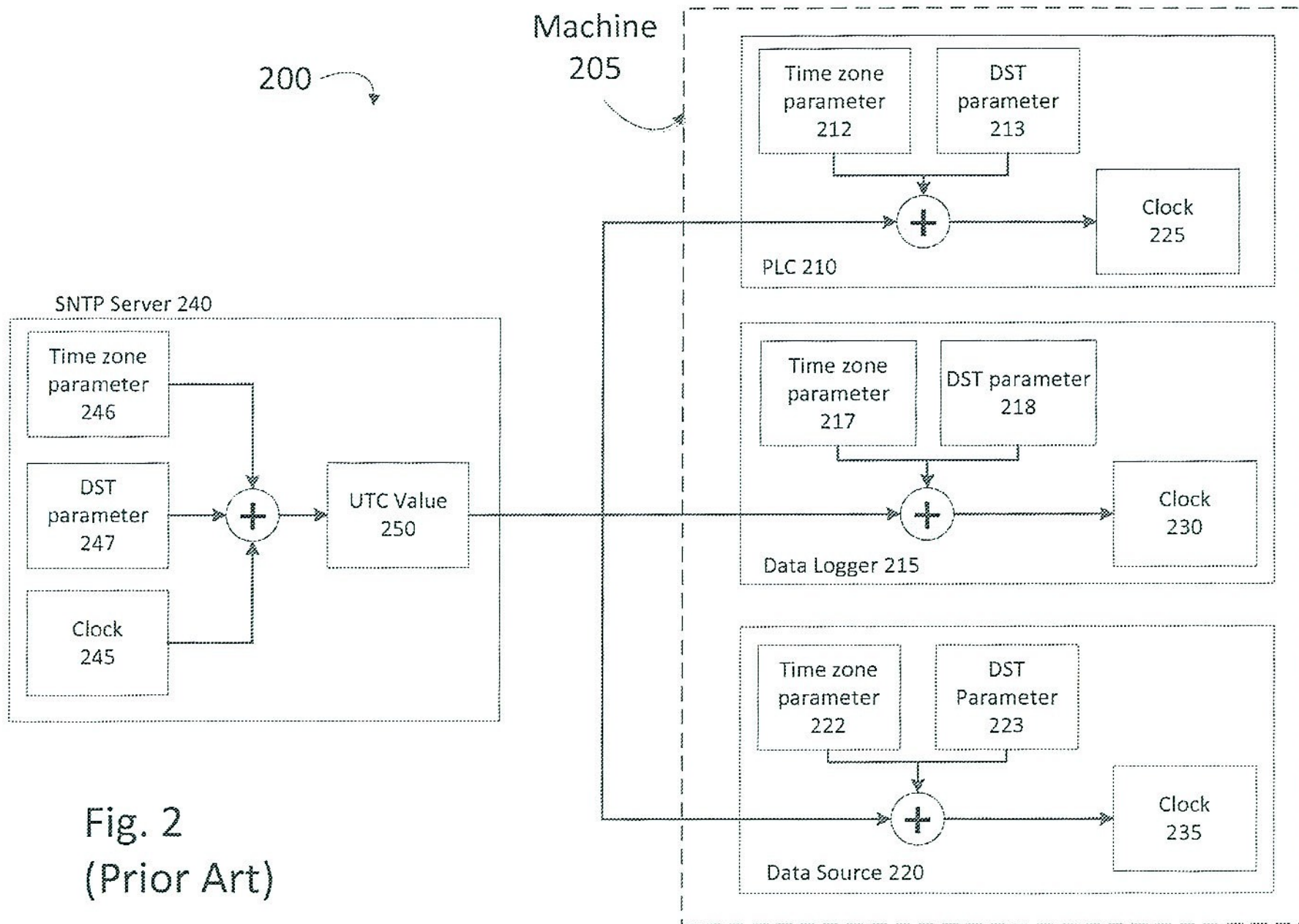


Fig. 2  
(Prior Art)

42

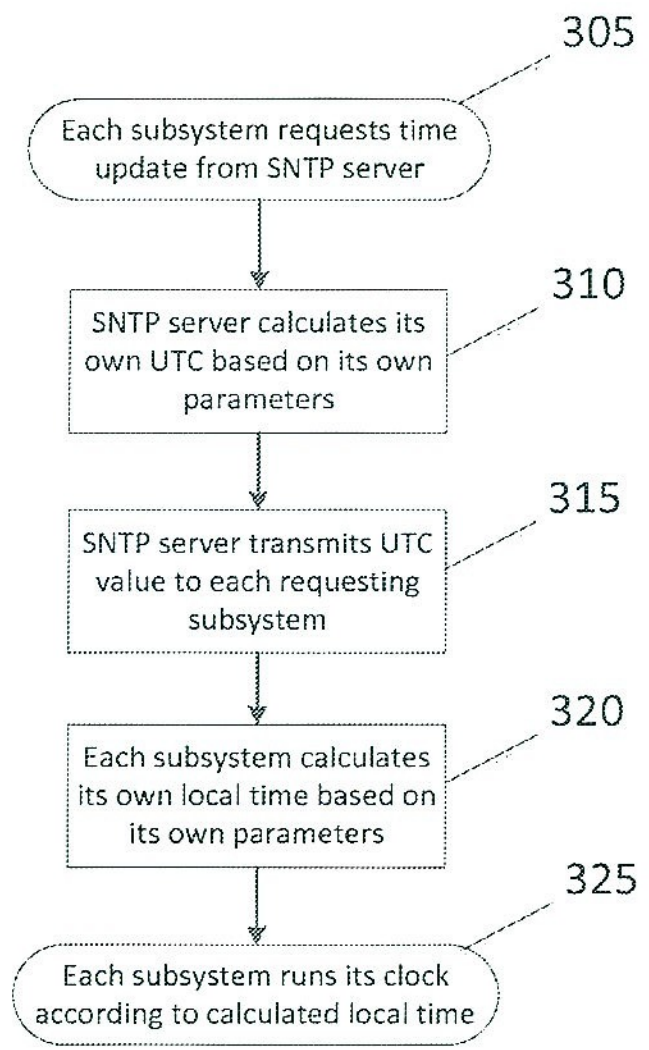


Fig. 3  
(Prior Art)

44

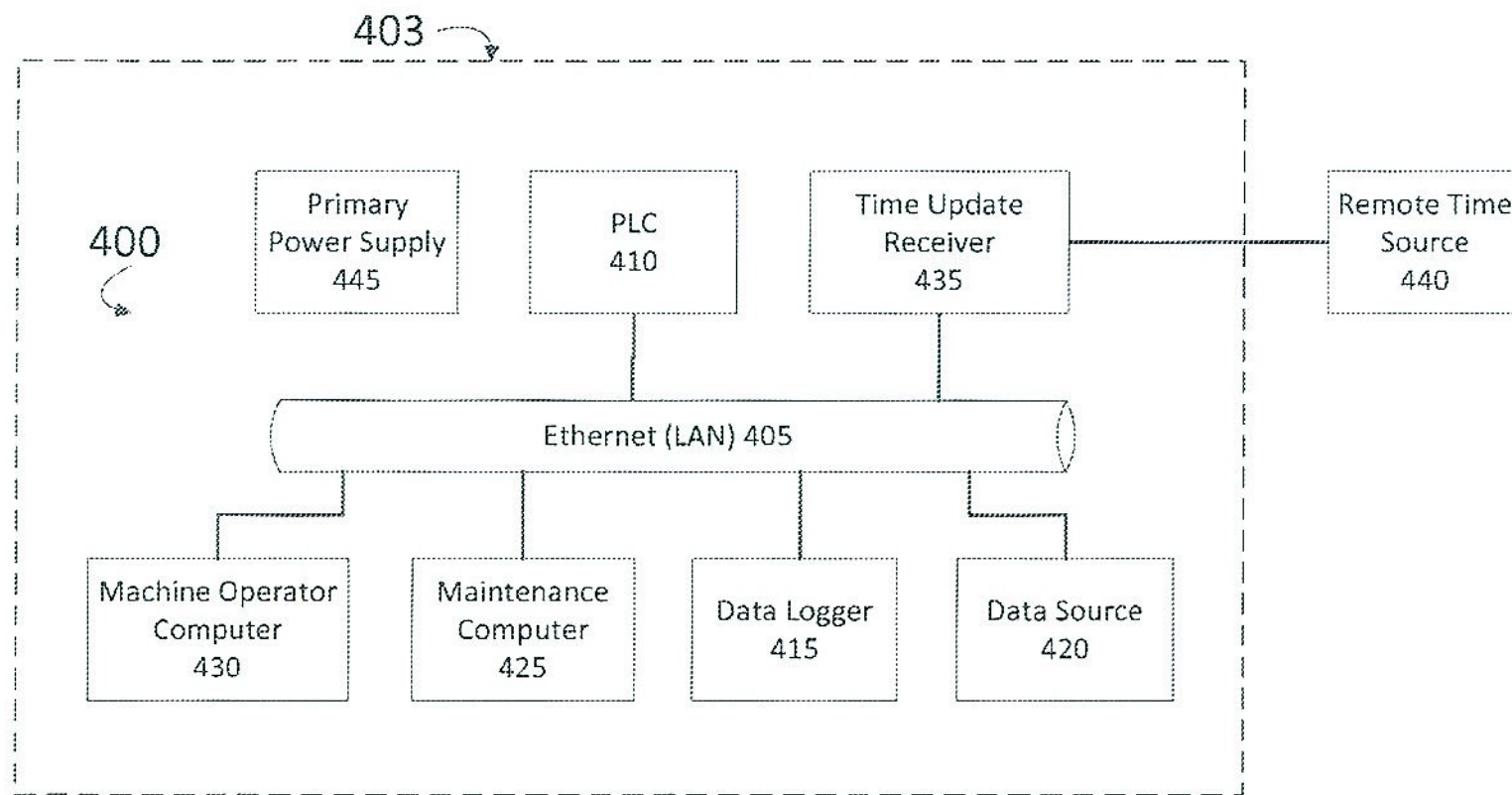


Fig. 4

44

45

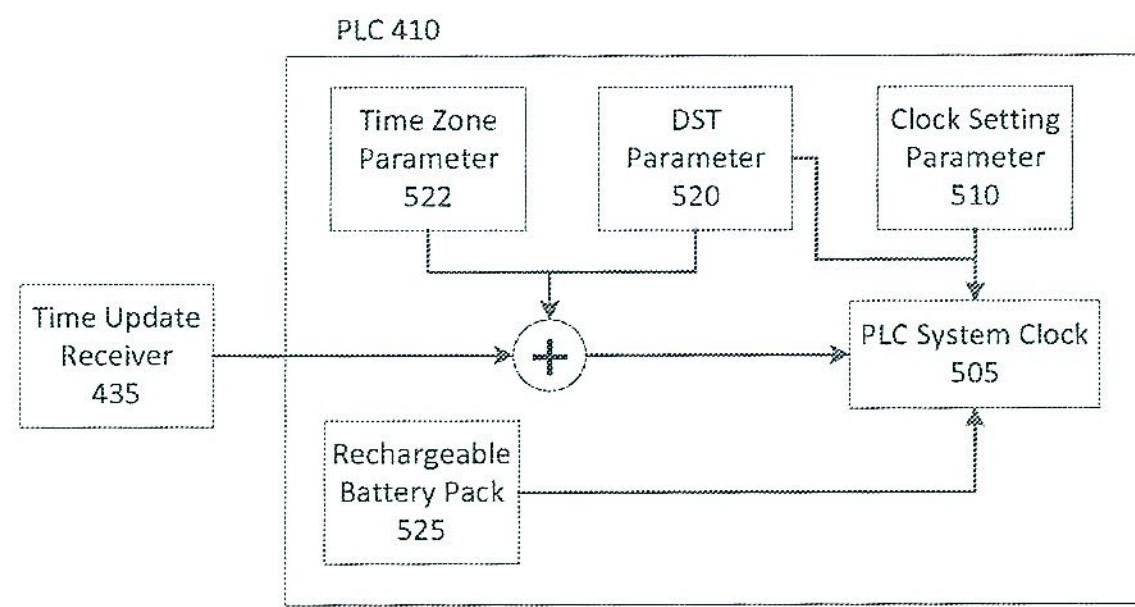


Fig. 5

45

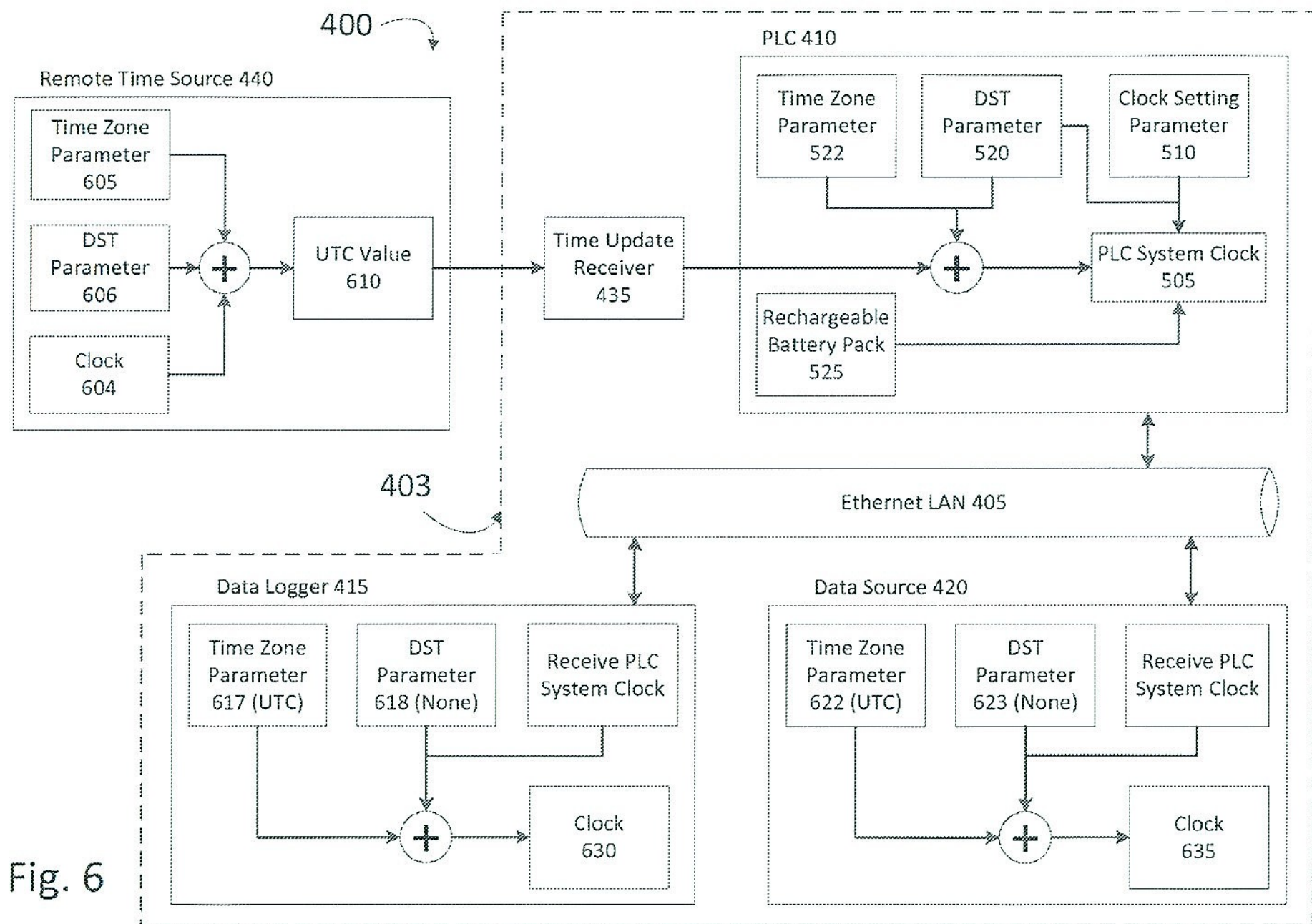


Fig. 6

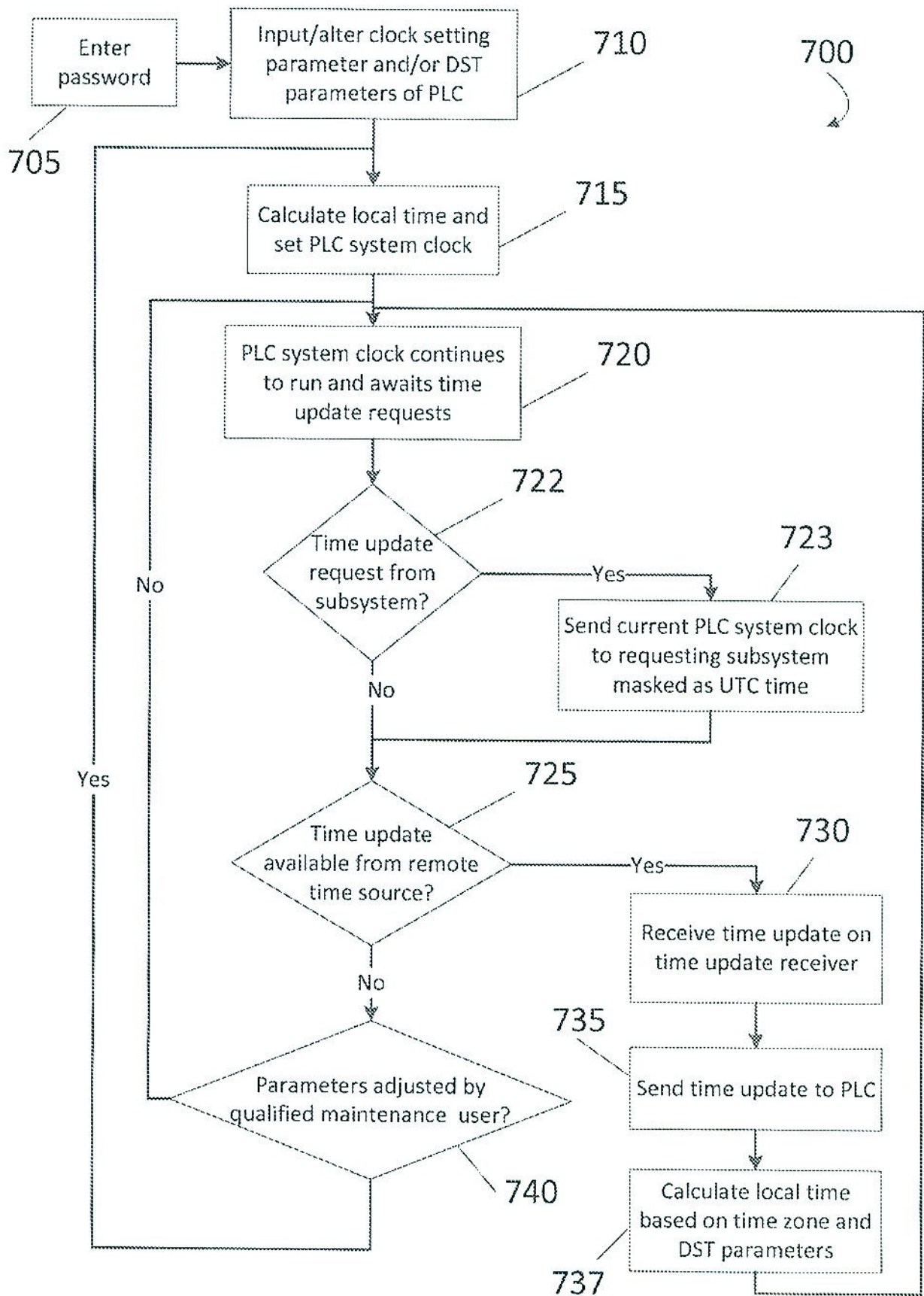


Fig. 7

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                  |                        |                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|------------------------|------------------|
| <b>Application Data Sheet 37 CFR 1.76</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                  | Attorney Docket Number | 043020-9161-US00 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                  | Application Number     |                  |
| Title of Invention                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | SYSTEM AND METHOD OF SYNCHRONIZING TIME BETWEEN MULTIPLE SYSTEMS |                        |                  |
| <p>The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.</p> <p>This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.</p> |                                                                  |                        |                  |

**Secrecy Order 37 CFR 5.2**

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

**Inventor Information:**

|                                                                                                                                                                          |            |                |             |                        |        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------|-------------|------------------------|--------|
| Inventor 1                                                                                                                                                               |            |                |             |                        | Remove |
| Legal Name                                                                                                                                                               |            |                |             |                        |        |
| Prefix                                                                                                                                                                   | Given Name | Middle Name    | Family Name | Suffix                 |        |
|                                                                                                                                                                          | Jorge      | A.             | Basulto     |                        |        |
| Residence Information (Select One) <input checked="" type="radio"/> US Residency <input type="radio"/> Non US Residency <input type="radio"/> Active US Military Service |            |                |             |                        |        |
| City                                                                                                                                                                     | Oconomowoc | State/Province | WI          | Country of Residence i | US     |

**Mailing Address of Inventor:**

|             |                       |                |    |  |  |
|-------------|-----------------------|----------------|----|--|--|
| Address 1   | 310 S. Daffodil Court |                |    |  |  |
| Address 2   |                       |                |    |  |  |
| City        | Oconomowoc            | State/Province | WI |  |  |
| Postal Code | 53066                 | Country i      | US |  |  |

|                                                                                                                                                                          |            |                |             |                        |        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------|-------------|------------------------|--------|
| Inventor 2                                                                                                                                                               |            |                |             |                        | Remove |
| Legal Name                                                                                                                                                               |            |                |             |                        |        |
| Prefix                                                                                                                                                                   | Given Name | Middle Name    | Family Name | Suffix                 |        |
|                                                                                                                                                                          | Charles    | D.             | Payne       |                        |        |
| Residence Information (Select One) <input checked="" type="radio"/> US Residency <input type="radio"/> Non US Residency <input type="radio"/> Active US Military Service |            |                |             |                        |        |
| City                                                                                                                                                                     | Mukwonago  | State/Province | WI          | Country of Residence i | US     |

**Mailing Address of Inventor:**

|             |                  |                |    |  |  |
|-------------|------------------|----------------|----|--|--|
| Address 1   | 105 Gordon Court |                |    |  |  |
| Address 2   |                  |                |    |  |  |
| City        | Mukwonago        | State/Province | WI |  |  |
| Postal Code | 53149            | Country i      | US |  |  |

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button.

Add

**Correspondence Information:**

Enter either Customer Number or complete the Correspondence Information section below.  
For further information see 37 CFR 1.33(a).

|                                           |                                                                  |                        |                  |
|-------------------------------------------|------------------------------------------------------------------|------------------------|------------------|
| <b>Application Data Sheet 37 CFR 1.76</b> |                                                                  | Attorney Docket Number | 043020-9161-US00 |
|                                           |                                                                  | Application Number     |                  |
| Title of Invention                        | SYSTEM AND METHOD OF SYNCHRONIZING TIME BETWEEN MULTIPLE SYSTEMS |                        |                  |

☐ An Address is being provided for the correspondence information of this application.

|                 |                             |                                          |                                             |
|-----------------|-----------------------------|------------------------------------------|---------------------------------------------|
| Customer Number | 23409                       |                                          |                                             |
| Email Address   | mkeipdocket@michaelbest.com | <input type="button" value="Add Email"/> | <input type="button" value="Remove Email"/> |

### Application Information:

|                                         |                                                                  |                                           |                          |
|-----------------------------------------|------------------------------------------------------------------|-------------------------------------------|--------------------------|
| Title of the Invention                  | SYSTEM AND METHOD OF SYNCHRONIZING TIME BETWEEN MULTIPLE SYSTEMS |                                           |                          |
| Attorney Docket Number                  | 043020-9161-US00                                                 | Small Entity Status Claimed               | <input type="checkbox"/> |
| Application Type                        | Nonprovisional                                                   |                                           |                          |
| Subject Matter                          | Utility                                                          |                                           |                          |
| Total Number of Drawing Sheets (if any) | 8                                                                | Suggested Figure for Publication (if any) | 1A                       |

### Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

### Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer number will be used for the Representative Information during processing.

|                    |                                                  |                                              |                                                         |
|--------------------|--------------------------------------------------|----------------------------------------------|---------------------------------------------------------|
| Please Select One: | <input checked="" type="radio"/> Customer Number | <input type="radio"/> US Patent Practitioner | <input type="radio"/> Limited Recognition (37 CFR 11.9) |
| Customer Number    | 23409                                            |                                              |                                                         |

### Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

|                                                                                                                       |                 |                                       |                                    |
|-----------------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------------|------------------------------------|
| Prior Application Status                                                                                              |                 | <input type="button" value="Remove"/> |                                    |
| Application Number                                                                                                    | Continuity Type | Prior Application Number              | Filing Date (YYYY-MM-DD)           |
|                                                                                                                       |                 |                                       |                                    |
| Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the <b>Add</b> button. |                 |                                       | <input type="button" value="Add"/> |

|                                           |                                                                  |                        |                  |
|-------------------------------------------|------------------------------------------------------------------|------------------------|------------------|
| <b>Application Data Sheet 37 CFR 1.76</b> |                                                                  | Attorney Docket Number | 043020-9161-US00 |
|                                           |                                                                  | Application Number     |                  |
| Title of Invention                        | SYSTEM AND METHOD OF SYNCHRONIZING TIME BETWEEN MULTIPLE SYSTEMS |                        |                  |

### Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

| <input type="button" value="Remove"/>                                                                                                       |                      |                          |                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------------|------------------------------------------|
| Application Number                                                                                                                          | Country <sup>i</sup> | Filing Date (YYYY-MM-DD) | Access Code <sup>j</sup> (if applicable) |
|                                                                                                                                             |                      |                          |                                          |
| <sup>i</sup> Additional Foreign Priority Data may be generated within this form by selecting the <input type="button" value="Add"/> button. |                      |                          |                                          |

### Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.<br>NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA. |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Authorization to Permit Access:

|                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Authorization to Permit Access to the Instant Application by the Participating Offices |
|----------------------------------------------------------------------------------------------------------------------------|

|                                           |                                                                  |                        |                  |
|-------------------------------------------|------------------------------------------------------------------|------------------------|------------------|
| <b>Application Data Sheet 37 CFR 1.76</b> |                                                                  | Attorney Docket Number | 043020-9161-US00 |
|                                           |                                                                  | Application Number     |                  |
| Title of Invention                        | SYSTEM AND METHOD OF SYNCHRONIZING TIME BETWEEN MULTIPLE SYSTEMS |                        |                  |

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

## Applicant Information:

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                        |                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|--------------------------------------|
| Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                        |                                      |
| <b>Applicant 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                        | <a href="#">Remove</a>               |
| <p>If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.</p> |                                                                        |                                      |
| <a href="#">Clear</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                        |                                      |
| <input checked="" type="radio"/> Assignee                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <input type="radio"/> Legal Representative under 35 U.S.C. 117         | <input type="radio"/> Joint Inventor |
| <input type="radio"/> Person to whom the inventor is obligated to assign.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <input type="radio"/> Person who shows sufficient proprietary interest |                                      |
| <p>applicant is the legal representative, indicate the authority to file the patent application, the inventor is:</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                        |                                      |

|                                                                                            |                                  |                |       |
|--------------------------------------------------------------------------------------------|----------------------------------|----------------|-------|
| Name of the Deceased or Legally Incapacitated Inventor :                                   |                                  |                |       |
| <p>If the Applicant is an Organization check here. <input checked="" type="checkbox"/></p> |                                  |                |       |
| Organization Name                                                                          | Harnischfeger Technologies, Inc. |                |       |
| <b>Mailing Address Information:</b>                                                        |                                  |                |       |
| Address 1                                                                                  | 2751 Centerville Road, Suite 342 |                |       |
| Address 2                                                                                  |                                  |                |       |
| City                                                                                       | Wilmington                       | State/Province | DE    |
| Country <sup>i</sup>                                                                       | US                               | Postal Code    | 19808 |
| Phone Number                                                                               |                                  | Fax Number     |       |

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| <b>Application Data Sheet 37 CFR 1.76</b>                                                |                                                                  | Attorney Docket Number | 043020-9161-US00                   |
|                                                                                          |                                                                  | Application Number     |                                    |
| Title of Invention                                                                       | SYSTEM AND METHOD OF SYNCHRONIZING TIME BETWEEN MULTIPLE SYSTEMS |                        |                                    |
| Email Address                                                                            |                                                                  |                        |                                    |
| Additional Applicant Data may be generated within this form by selecting the Add button. |                                                                  |                        | <input type="button" value="Add"/> |

## Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |                |             |                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------|-------------|---------------------------------------|
| <b>Assignee 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |                |             |                                       |
| Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication. |            |                |             |                                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |                |             | <input type="button" value="Remove"/> |
| If the Assignee is an Organization check here. <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                |            |                |             |                                       |
| Prefix                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Given Name | Middle Name    | Family Name | Suffix                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |                |             |                                       |
| <b>Mailing Address Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                    |            |                |             |                                       |
| Address 1                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                |             |                                       |
| Address 2                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                |             |                                       |
| City                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            | State/Province |             |                                       |
| Country i                                                                                                                                                                                                                                                                                                                                                                                                                                              |            | Postal Code    |             |                                       |
| Phone Number                                                                                                                                                                                                                                                                                                                                                                                                                                           |            | Fax Number     |             |                                       |
| Email Address                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |                |             |                                       |
| Additional Assignee Data may be generated within this form by selecting the Add button.                                                                                                                                                                                                                                                                                                                                                                |            |                |             | <input type="button" value="Add"/>    |

## Signature:

|                                                                                                                             |                    |           |                   |                                    |
|-----------------------------------------------------------------------------------------------------------------------------|--------------------|-----------|-------------------|------------------------------------|
| NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications |                    |           |                   |                                    |
| Signature                                                                                                                   | /kevin p. rizzuto/ |           | Date (YYYY-MM-DD) | 2013-09-09                         |
| First Name                                                                                                                  | Kevin              | Last Name | Rizzuto           | Registration Number 59229          |
| Additional Signature may be generated within this form by selecting the Add button.                                         |                    |           |                   | <input type="button" value="Add"/> |

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|                                           |                                                                  |                        |                  |
|-------------------------------------------|------------------------------------------------------------------|------------------------|------------------|
| <b>Application Data Sheet 37 CFR 1.76</b> |                                                                  | Attorney Docket Number | 043020-9161-US00 |
|                                           |                                                                  | Application Number     |                  |
| Title of Invention                        | SYSTEM AND METHOD OF SYNCHRONIZING TIME BETWEEN MULTIPLE SYSTEMS |                        |                  |

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