**Industria y Comercio**

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PCT

SOLICITUD

# PATENTE DE INVENCIÓN

21 EXPEDIENTE Nº 04-39940

54 TÍTULO Paquete de Herramientas Internamente enfriados

51 CLASIFICACIÓN INTERNACIONAL B21D 37/16

71 SOLICITANTE Sega Can Machinery. Inc

DOMICILIO New Jersey, Estados Unidos

74 APODERADO Dilia María Rodríguez D' Aleman

22 BOGOTÁ, D. C. Abril 30, 2004

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(FORMA P 10)

PETITO

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Industria y Comercio
SUPERINTENDENCIA

# FORMULARIO ÚNICO DE SOLICITUD DE PATENTE
## PCT
## ENTRADA EN FASE NACIONAL

**1) SOLICITUD DE:**

☒ Patente de invención ☐ Patente de Modelo de Utilidad

☐ Capitulo I. ☒ Capitulo II.

| | | |
|---|---|---|
| **2) SOLICITANTE (71)** | **Nombre: Sequa Can Machinery Inc.**<br><br>**Dirección: 401 Central Avenue, East Rutherford NJ 07073, Estados Unidos**<br><br>**Nacionalidad o domicilio: New Jersey, Estados Unidos**<br><br>**Lugar de constitución: New Jersey, Estados Unidos** | **IDENTIFICACIÓN**<br>**C.C.** ☐ **NIT:** ☐<br>**C.E.** ☐ **OTRO** ☐<br>**Cual** _____<br>**NÚMERO** _____ |
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**6)Título (54) PAQUETE DE HERRAMIENTAS INTERNAMENTE ENFRIADO**

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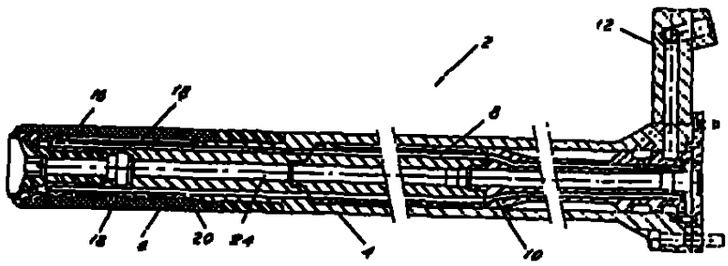
Instrucciones para el diligenciamiento del presente formulario. Ver reverso de esta pagina

**10) ANEXOS**

- [x] Comprobante de pago de la tasa de presentación de la solicitud ✓
- [ ] Comprobante de pago por reivindicación de prioridad
- [ ] Documento que acredita la existencia y representación legal cuando el solicitante sea persona Jurídica
- [ ] Poderes, si fuera el caso
- [ ] Documento de cesión del inventor al solicitante o a su causante
- [ ] Declaraciones
- [x] Copia de la solicitud Internacional. (Resumen, descripción, reivindicación, Dibujos). ✓
- [x] Traducción de la solicitud internacional al castellano. (Resumen, descripción, reivindicación, Dibujos) ✓
- [x] Copia del examen preliminar efectuado por la IPEA
- [ ] De ser el caso, copia del contrato de acceso
- [ ] De ser el caso, documento que acredite la licencia o autorización de uso de conocimientos tradicionales de las comunidades indígenas
- [ ] De ser el caso, certificado de depósito del material biológico
- [x] Arte final 12 x 12 y 6 x 6 cm ✓
- [ ] De ser el caso, información sobre otras solicitudes de patente o títulos obtenidos en el extranjero por el mismo titular o su causante, relacionados parcial o totalmente con la invención de esta solicitud.
- [ ] Otros

1. Reporte internacional de búsqueda ✓
2. Notificación de la transmisión del examen preliminar ✓
3. Solicitud de patente PCT /
4. Notificación de oficinas designada /

**11) FIGURA CARACTERÍSTICA:**




**12) Solicitud concesión de la patente,**

**NOMBRE:** DILIA RODRÍGUEZ D'ALEMAN

**FIRMA:**

**C.C. 41.654.882 de Bogota TP 20824 CSJ**

**Instrucciones para el diligenciamiento del presente formulario. Ver reverso de esta pagina**

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| CANT. | REMTISTICO | CONCEPTO | TOTAL CONCEPTO |
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| 1 | 50005-01-01 SOLICITUDES | 1 TRAMITES DE SOL. DE PATENTE DE IN | 422,000.00 |
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SON: CUATROCIENTOS VEINTIDOS MIL PESOS

RESPONSABLE : _____

RECIBO DE CAJA APLICADO AL EXPEDIENTE No._____

P 0-003

# TROQUEL INTERNAMENTE ENFRIADO

## CAMPO DE LA INVENCION

La presente invención se refiere generalmente a troqueles útiles para formar latas a partir de copas y particularmente para formar latas de dos piezas, y muy específicamente a dichos troqueles que son enfriados internamente.

## ANTECEDENTES DE LA INVENCION

Las máquinas conformadoras se utilizan para formar los cuerpos de recipientes metálicos. Una copa metálica hueca es impulsada a través de un conjunto de dados de conformación anular por medio de un troquel para formar el cuerpo más alargado de la lata, por ejemplo, en un proceso de estirado y planchado conocido. Un ejemplo de una máquina conformadora de latas convencional se muestra en la Patente EUA número 4,173,882 expedida a Lee, Jr. el 13 de noviembre de 1979, cuya descripción detallada se incorpora en la presente invención por referencia.

Típicamente, un troquel separado es

asegurado de manera removible en el extremo delantero de un ariete oscilante en una máquina de estirado y planchado. El troquel provee un mandril interior en el que se puede configurar, estirar y planchar la lata, conforme ésta pasa a través de dados sucesivos. La temperatura del troquel debería ser controlada contra el calor generado en el troquel debido al contacto friccional repetido entre el troquel, el interior del cuerpo de la lata, y los dados pasados que el troquel mueve.

En una formación de lata convencional, refrigerantes externamente aplicados mantienen las condiciones de temperatura operativa. Sin embargo, en algunas aplicaciones de formación de latas, es conveniente excluir el uso convencional de refrigerantes externos. Los refrigerantes externos pueden contaminar las superficies del recipiente, lo que después requeriría procesos de limpieza posteriores a la formación que son costosos y que pueden resultar ambientalmente indeseables.

Las disposiciones previas enfriaban internamente un troquel. La Patente EUA número 4,502,313 a Phalin et al., describe un solo paso de entrada de refrigerante y un solo paso de salida de refrigerante que permite que un líquido

refrigerante fluya a través de una muesca helicoidal adyacente al interior del troquel. La Patente EUA número 5,687,604 a Robbins, las Patentes EUA números 5,233,912 y 5,048,592 a Mueller, y la Patente EUA número 5,678,442 a Ohba et al., describen tubos de suministro y descarga de refrigerantes a través de conductos centrales. La Patente EUA número 6,035,688 a Nagao et al., utiliza un solo paso continuo para suministrar refrigerante. Los sistemas de la técnica anterior no son convenientes porque no reducen al mínimo los gradientes de temperatura de dirección circunferencial dentro del ariete y no proveen el enfriamiento uniforme del troquel.

## SUMARIO DE LA INVENCION

La presente invención supera las desventajas de los troqueles internamente enfriados la técnica anterior suministrando fluido, y particularmente refrigerante, a través de una pluralidad de tubos de transferencia de fluido dispuestos anularmente para puertos dispuestos radialmente. Cada puerto se alimenta dentro de un canal circunferencial adyacente a la superficie

interior del troquel que está colocado en y sobre la región de extremo del ariete dentro del troquel. El troquel internamente enfriado no requiere el uso de refrigerantes externos. La temperatura exterior del troquel se puede monitorear continuamente, por ejemplo, mediante contacto directo con el troquel o mediante el monitoreo de la temperatura del fluido que enfrió el troquel, y la temperatura media del refrigerante se puede ajustar automáticamente para mantener temperaturas de troquel aceptables.

El medio de refrigerante se suministra mediante una unidad de control de temperatura y se administra al troquel a través de una serie de tubos que corren a través del ariete. Los tubos de entrada dirigen el medio refrigerante hacia el extremo distal o delantero del ariete y al troquel que está ahí. Los tubos de salida ubicados más próximamente o hacia atrás regresan el medio refrigerante fuera del troquel. Múltiples tubos de entrada y salida paralelos están separados circunferencial y simétricamente alrededor de la periferia del troquel, en donde los tubos de entrada y salida se alternan para distribuir los medios de fluido uniformemente alrededor de la superficie interior del troquel. El diseño múltiple

de entrada y salida de fluido con aberturas simétricas, ayuda a garantizar que la temperatura del troquel permanezca constante, reduciendo al mínimo los gradientes de temperatura circunferenciales.

Preferentemente, los tubos de transferencia de fluido están construidos en materiales con propiedades de baja transferencia térmica para reducir al mínimo la transferencia de calor a la pared del ariete dentro del troquel. La reducción al mínimo de la transferencia de calor entre el medio de fluido y el ariete es conveniente para mantener la transferencia de calor de fluido precisa entre el medio de fluido y el ariete, las temperaturas de entrada del medio de fluido y para reducir al mínimo la distorsión del ariete debido a los gradientes térmicos. Los gradientes térmicos circunferenciales en el ariete, pueden distorsionar el ariete, alterando de manera adversa la alineación del troquel.

La abertura entre los tubos de transferencia es circunferencialmente simétrica, con puertos de entrada y salida alternos, para reducir al mínimo cualesquiera gradientes de temperatura circunferenciales que se pudieran

transferir al ariete o superficie del troquel que pudieran distorsionar dicho ariete o superficie. Los puertos de entrada y salida que alternan simétricamente, distribuyen de manera uniforme el medio de fluido radialmente a la superficie interior del troquel, alrededor del exterior del ariete. Los tubos de transferencia también rodean un puerto central separado para el flujo de aire y ayudan a que ese flujo saquen el recipiente del troquel.

Otras características y ventajas de la presente invención serán aparentes a partir de la siguiente descripción de la invención que se refiere a las figuras anexas.

## BREVE DESCRIPCION DE LAS FIGURAS

La figura 1 es una sección transversal en elevación de un ensamble de troquel internamente enfriado de acuerdo con la presente invención.

La figura 2 es una sección transversal en elevación del ensamble de troquel de la figura 1 y que ilustra las trayectorias del medio de refrigerante que fluyen al interior del ensamble.

La figura 3 es una vista en plano

transversal que detalla un colector de admisión del ensamble de troquel de la figura 1.

La figura 4 es una vista agrandada del extremo distal del ensamble de troquel que se muestra en la figura 2 y que ilustra el suministro del medio de refrigerante.

La figura 5 es una sección transversal que muestra el extremo proximal del ensamble de troquel de la figura 1 y que ilustra el flujo de fluido al troquel de acuerdo con la presente invención.

La figura 6 es una sección transversal del ensamble de troquel de la figura 1 que muestra las trayectorias de descarga del medio de refrigerante.

La figura 7 es una vista en plano transversal que detalla un colector de salida del ensamble de troquel de la figura 1.

La figura 8 es una vista agrandada del extremo distal del ensamble de troquel, tal como se muestra en la figura 2, y que ilustra la descarga de los medios refrigerantes del troquel.

## DESCRIPCION DE LAS MODALIDADES PREFERIDAS

La figura 1 muestra un ensamble de troquel internamente enfriado 2 de acuerdo con la presente

invención en sección transversal. El ensamble incluye un ariete oscilante 4 que es convencionalmente oscilado a través de una serie de dados (que no se muestran) de un ensamble de herramienta de conformación de recipiente (que no se muestra). Dicho ensamble de herramienta se puede apreciar en una solicitud copendiente titulada "PAQUETE DE HERRAMIENTAS INTERNAMENTE ENFRIADO" y presentada junto con la presente invención. La región de extremo delantero, exterior o distal del ariete de un diámetro exterior estrechado. Un troquel 6 está colocado de manera removible en la región de extremo distal estrechado del ariete.

Como se puede apreciar en las figura 1 y 5, una pluralidad de tubos de entrada de transferencia de fluido 8 para suministrar el medio refrigerante y una pluralidad de tubos exteriores de transferencia de fluido 10 para descargar el medio refrigerante están formados dentro del ariete 4, anularmente en una disposición circunferencial, simétrica, en donde se alternan los tubos 8 y 10. Un colector 12 para conexión con una unidad de control de temperatura 13 se provee en un extremo proximal del ensamble de troquel y se conecta por lo menos a uno de los tubos 8 y/o 10.

Las figuras 2-5 muestran el suministro del medio refrigerante al troquel. La figura 2 ilustra el flujo del medio refrigerante a una unidad de control de temperatura de medio refrigerante 13 de diseño convencional (figura 3) dentro de una porción de entrada del colector 12 dentro del ariete 4 hacia el extremo distal a lo largo de los tubos de transferencia de entrada 8, tal como se muestra mediante las flechas en la figura 4. La porción de entrada 14 del colector 12 se muestra en la figura 3. Cuando la porción de entrada 4 está cerca en el extremo distal, el medio refrigerante fluye radialmente hacia fuera desde los tubos 8 a través del puerto radial 16 a un canal o espacio 18 que se extiende a lo largo de la superficie de perforación o interior del troquel 6.

Las figuras 6-8 muestran la descarga del medio refrigerante del troquel. La figura 6 ilustra el flujo del medio refrigerante desde el extremo proximal del espacio o canal 18, radialmente a través de un puerto de salida 20, saliendo del canal 18 hacia una salida 22 del colector 12. El medio refrigerante fluye hacia atrás o de manera proximal a lo largo del tubo de transferencia de salida 10, con la dirección del flujo de salida

indicada por las flechas en la figura 8.

La figura 5 muestra que las pluralidades respectivas de los tubos de entrada 8 y de salida 10 están provistas en el ariete 4 en una disposición anular que alterna. Similarmente, los puertos de entrada 16 y los puertos de salida 20 al canal de fluido 18 están provistos en una disposición anular, simétrica para distribuir el medio refrigerante de manera uniforme a la superficie interior del troquel. El espacio o canal 18 puede comprender una serie de paso o canales parcialmente circunferenciales individuales o un solo canal circunferencial alrededor del interior del troquel con soportes separados para el troquel ubicado en ese espacio. Debido a que los tubos respectivos de entrada 8 y de salida 10 están circunferencialmente desviados, ya sea que el espacio sea lo suficientemente largo circunferencialmente y/o los puertos de entrada y salida 16 y 20 estén orientados para que el medio fluya dentro del troquel, tal como se describió.

Los tubos de transferencia de fluido 8 y 10 están formados de materiales con propiedades de baja transferencia térmica para reducir al mínimo la transferencia de calor entre el medio de fluido

y el ariete, para mantener temperaturas de entrada precisas de medio de fluido y para reducir al mínimo la distorsión del ariete debido a los gradientes térmicos circunferenciales. Dichos gradientes térmicos serían adversos para mantener la rectilineidad del ariete. La temperatura del ariete se enfría mediante el medio de fluido, y se enfría uniformemente para mantener la rectilineidad. Además, el fluido también se puede calentar para elevar la temperatura del ariete, por ejemplo al arranque de la máquina. Esto puede ser deseable para reducir al mínimo los efectos de la expansión térmica y mejorar los procesos de estirado, planchado y desmonte.

Para mantener un nivel de temperatura correcto, la temperatura del troquel se puede monitorear continuamente por medio de una sonda pirométrica 23 que se comunica con el troquel 6 cerca del extremo distal del mismo, por ejemplo, en el exterior o en el interior del troquel, en el exterior del ariete o monitoreando la temperatura del líquido en el espacio 18.

Se utiliza un puerto central separado 24 colocado axialmente en el ariete 4 para que el flujo de aire ayude en el desmonte del recipiente

formado del troquel.

Aunque la presente se ha descrito en relación con modalidades particulares de la misma, para aquellos expertos en la técnica se volverán aparentes muchas otras variaciones y modificaciones así como otros usos. Por lo tanto, la presente invención estará limitada no por la descripción específica en la presente invención, sino únicamente por las reivindicaciones anexas.

## NOVEDAD DE LA INVENCION

Habiendo descrito el presente invento, se considera como una novedad y, por lo tanto, se reclama como prioridad lo contenido en las siguientes:

## REIVINDICACIONES

1.- Un ensamble de troquel para producir un cuerpo de recipiente impulsando una copa monumental a través de un medio de dado tipo anillo, el ensamble de troquel comprende: un ariete que tiene extremos proximal y distal; un troquel colocado sobre el extremo distal del ariete, el troquel tiene una superficie interna; un colector conectado al extremo proximal del ariete; una disposición anular de tubos de entrada de fluido circunferencialmente separados en el ariete para suministrar un medio refrigerante desde el colector hacia el extremo distal del ariete; y una pluralidad de puertos de entrada radiales desde los tubos de entrada hasta la superficie interior para suministrar el medio refrigerante a la superficie interior del troquel; una disposición anular de

tubos de salida de fluido circunferencialmente separados en el ariete para retirar el medio refrigerante; una pluralidad de puertos de salida radiales desde la superficie interior, y separados de los puertos de entrada a lo largo de la longitud del ariete para transferir el medio refrigerante de la superficie interior del troquel a los tubos de salida.

2.- El ensamble de troquel de conformidad con la reivindicación 1, caracterizado porque los puertos de entrada están más distantes y los puertos de salida están más próximos a lo largo del ariete, en donde la superficie interior define un espacio entre cada puerto de entrada y por lo menos un puerto de salida.

3.- El ensamble de troquel de conformidad con la reivindicación 1, caracterizado porque las disposiciones anulares de los tubos de entrada y los tubos de salida están colocadas de manera que los tubos de entrada y de salida alternan.

4.- El ensamble de troquel de conformidad con la reivindicación 3, caracterizado porque los tubos de entrada y de salida están paralelos.

5.- El ensamble de troquel de conformidad con la reivindicación 1, caracterizado porque el

troquel tiene un extremo proximal y los puertos de salida están cerca del extremo proximal del troquel.

6.- El ensamble de troquel de conformidad con la reivindicación 1, que además comprende un puerto central en el ariete para que el flujo de aire ayude a desmontar el recipiente del troquel.

7.- El ensamble de troquel de conformidad con la reivindicación 1, que además comprende una unidad de control de temperatura para suministrar un medio refrigerante dentro del colector.

8.- El ensamble de troquel de conformidad con la reivindicación 7, que además comprende medios para monitorear la temperatura exterior del troquel para controlar la temperatura del medio refrigerante.

9.- El ensamble de troquel de conformidad con la reivindicación 1, caracterizado porque los tubos de transferencia están construidos de materiales que tienen propiedades de baja transferencia térmica.

## RESUMEN DE LA INVENCION

Un troquel internamente enfriado (6) colocado en el extremo de un ariete (4) en una máquina de conformación de latas; los medios de enfriamiento de fluido interno en el ariete (4) evitan la necesidad de refrigerantes externamente aplicados; una pluralidad de tubos de transferencia de fluido paralelos (8, 10) está colocada anularmente con el ariete (4); el medio refrigerante fluye a través de los tubos de entrada (8) a los puertos de entrada radiales (16) que suministran el medio refrigerante a la superficie interior del troquel (6), en donde el medio fluye hacia atrás a través de un canal (18) en la superficie interior del troquel (6) a los puertos de salida radiales (20) conduciéndose a los tubos de salida (10) a través del ariete (4); los medios refrigerantes descargados fluyen de regreso a lo largo del ariete y fuera a través del colector (12); los tubos de transferencia (8, 10) están dispuestos simétricamente en una disposición que alterna circunferencialmente alrededor del ariete (4) para reducir los gradientes de temperatura radiales dentro del ariete (4); un puerto central

(24) permite el flujo de aire a través del ariete (4) para ayudar a desmontar el recipiente formado del troquel (6).

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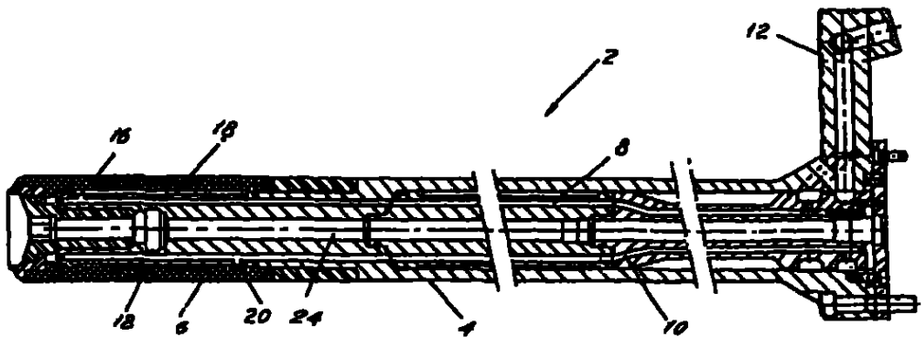
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: INTERNALLY COOLED PUNCH




(57) Abstract: An internally cooled punch (6) disposed on the end of a ram (4) in a can forming machine. Internal fluid cooling means in the ram (4) avoids the need for externally applied cooling fluids. A plurality of parallel fluid transfer tubes (8, 10) is arranged annularly with the ram (4). Cooling medium flows through inlet tubes (8) to radial inlet ports (16) which supply the cooling medium to the inner surface of the punch (6) where the medium flows rearwardly through a channel (18) at the inner surface of the punch (6) to radial outlet ports (20) leading to outlet tubes (10) through the ram (4). Discharged cooling media flows back along the ram and out through a manifold (12). The transfer tubes (8, 10) are arranged symmetrically in an alternating array circumferentially around the ram (4) to reduce radial temperature gradients within the ram (4). A central port (24) allows air flow through the ram (4) to aid in stripping the formed container from the punch (6).

WO 03/039783 A1

# INTERNALLY COOLED PUNCH

## BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates generally to punches useful in forming cans from cups and particularly for two piece can forming, and more specifically to such punches that are internally cooled.

2. Brief Description of the Related Art:

Forming machines are used to form the bodies of metal containers. A shallow metal cup is driven through a set of annular forming dies by a punch to form the more elongate body of the can, e.g. in a known drawing and ironing process. An example of a conventional can forming machine is shown in U.S. Patent No. 4,173,882 issued to Lee, Jr. on November 13, 1979, the entire disclosure of which is incorporated herein by reference.

A separate punch typically is removably secured on the leading end of a reciprocating ram in a drawing and ironing machine. The punch provides an inner mandrel on which the can is shaped, drawn, and ironed as it passes through successive dies. The temperature of the punch should be controlled against the heat generated in the punch by repeated frictional contact between the punch, the inside of the can body, and the dies past which the punch moves.

In conventional can formation, externally applied cooling fluids maintain operational temperature conditions. In some can forming applications, however, it is desirable to exclude the conventional use of external cooling fluids. The external cooling fluids may contaminate the container surfaces which would then require post-formation cleaning processes that are costly and may be environmentally undesirable.

and outlet tubes alternating to distribute the fluid media uniformly around the inner surface of the punch. The multiple fluid inlet and outlet design with symmetrical porting helps assure that the punch temperature remains constant, minimizing circumferential temperature gradients.

Preferably, the fluid transfer tubes are constructed from materials with low thermal transfer properties to minimize heat transfer to the wall of the ram inside the punch. Minimizing heat transfer between the fluid medium and the ram is desirable to maintain accurate fluid heat transfer between the fluid medium and the ram, accurate fluid media inlet temperatures and to minimize ram distortion due to thermal gradients. Circumferential thermal gradients in the ram may distort the ram, adversely altering punch alignment.

Porting between the transfer tubes is circumferentially symmetrical, with alternating inlet and outlet ports, to minimize any circumferential temperature gradients that could transfer to and distort the ram or the surface of the punch. The symmetrically alternating inlet and outlet ports uniformly distribute the fluid medium radially to the inner surface of the punch around the outside of the ram. The transfer tubes also surround a separate central port for air flow and aids that flow in stripping the container from the punch.

Other features and advantages of the present invention will become apparent from the following description of the invention which refers to the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an elevational cross section of an internally cooled punch assembly according to the present invention.

Fig. 2 is an elevational cross section of the punch assembly of Fig. 1 and illustrating cooling fluid medium pathways flowing into the assembly.

Fig. 3 is a cross sectional plan view detailing an inlet manifold of the

proximal end of the punch assembly and connects to at least one of the tubes 8 and/or 10.

Figs. 2-5 show the supply of fluid cooling medium to the punch. Figure 2 illustrates flow of cooling medium from a fluid medium temperature control unit 13 of conventional design (Fig. 3) into an inlet portion of manifold 12 into ram 4 toward the distal end along inlet transfer tubes 8 as shown by arrows in Fig. 4. The inlet portion 14 of manifold 12 is shown in Fig. 3. When the inlet portion 14 is nearly at the distal end, the cooling medium flows radially outward from tubes 8 through radial port 16 to a channel or clearance 18 extending along the inner or bore surface of the punch 6.

Figs. 6-8 show the discharge of the cooling medium from the punch. Fig. 6 illustrates the flow of cooling medium from the proximal end of the clearance or channel 18, radially through an outlet port 20 exiting channel 18 to an outlet 22 of the manifold 12. The cooling medium flows rearward or proximally along outlet transfer tube 10, with the direction of outlet flow indicated by the arrows in Fig. 8.

Fig. 5 shows that the respective pluralities of inlet 8 and outlet tubes 10 are provided in ram 4 in an alternating annular arrangement. Similarly, inlet ports 16 and outlet ports 20 to fluid channel 18 are provided in a symmetrical, annular arrangement to distribute the cooling medium uniformly to the inner surface of the punch. The clearance or channel 18 may comprise a series of individual partially circumferential passages or channels or a single circumferential channel around the inside of the punch with spaced supports for the punch located in that clearance. Since the respective inlet 8 and outlet 10 tubes are circumferentially offset, either the clearance is circumferentially large enough and/or the inlet and outlet ports 16 and 20 are angled such that medium will flow inside the punch as described.

Fluid transfers tubes 8 and 10 are formed of materials with low thermal

WHAT IS CLAIMED IS:

1. A punch assembly for producing a container body by driving a formidable cup through a ring type die means, the punch assembly comprising:

a ram having proximal and distal ends;

a punch disposed over the distal end of the ram, the punch having an internal surface;

a manifold connected to the proximal end of the ram;

an annular array of circumferentially spaced fluid inlet tubes in the ram for supplying cooling fluid medium from the manifold toward the distal end of the ram; and

a plurality of radial inlet ports from the inlet tubes to the internal surface for supplying the cooling medium to the internal surface of the punch;

an annular array of circumferentially spaced fluid outlet tubes in the ram for removing cooling medium;

a plurality of radial outlet ports from the internal surface, and spaced from the inlet ports along the length of the ram for transferring cooling medium from the internal surface of the punch to the outlet tubes.

2. The punch assembly of claim 1, wherein the inlet ports are more distal and the outlet ports are more proximal along the ram, with the internal surface defining a clearance between each inlet port and at least one outlet port.

3. The punch assembly of claim 1, wherein the annular arrays of inlet tubes and outlet tubes are arranged with the inlet and outlet tubes alternating.

4. The punch assembly of claim 3, wherein the inlet and outlet tubes are parallel.

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PCT/US02/34895

FIG 1

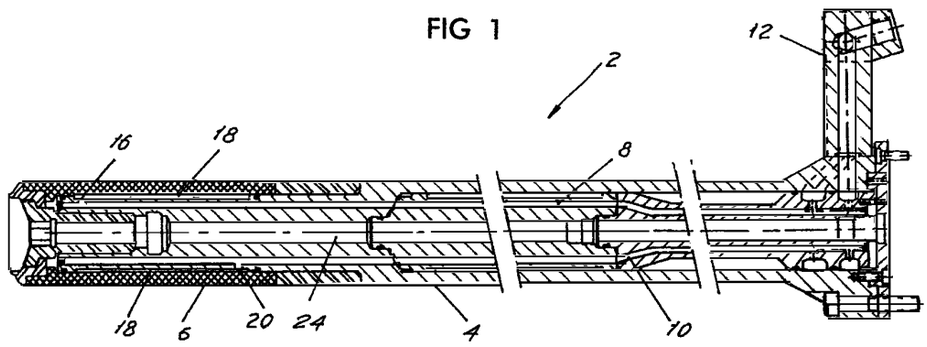


FIG 2

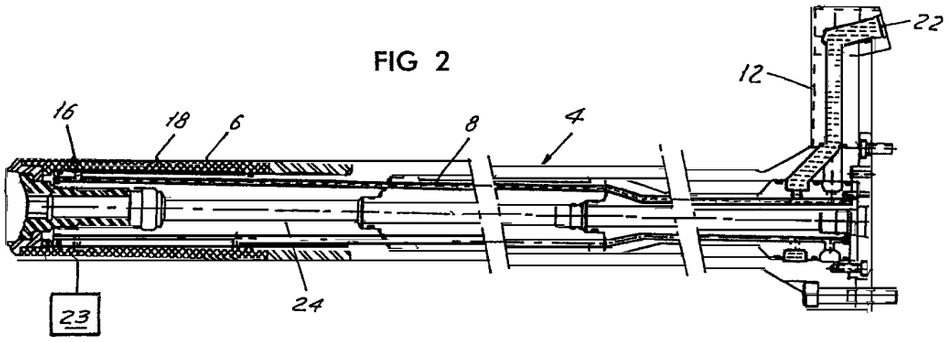
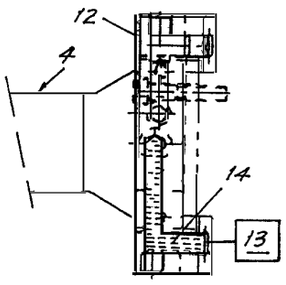



FIG 3



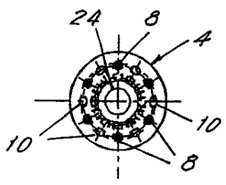



FIG 5

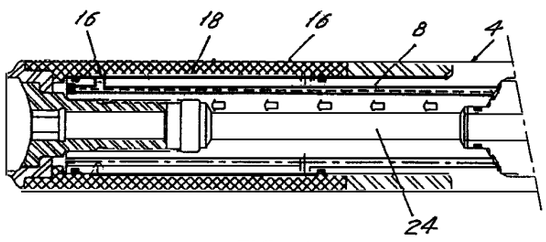



FIG 4

FIG 8

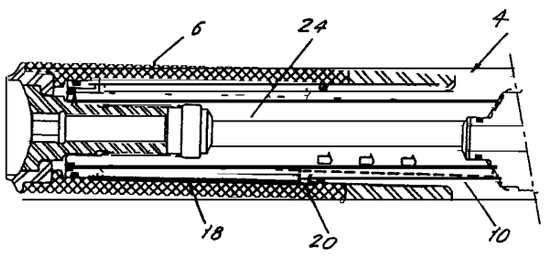


FIG 6

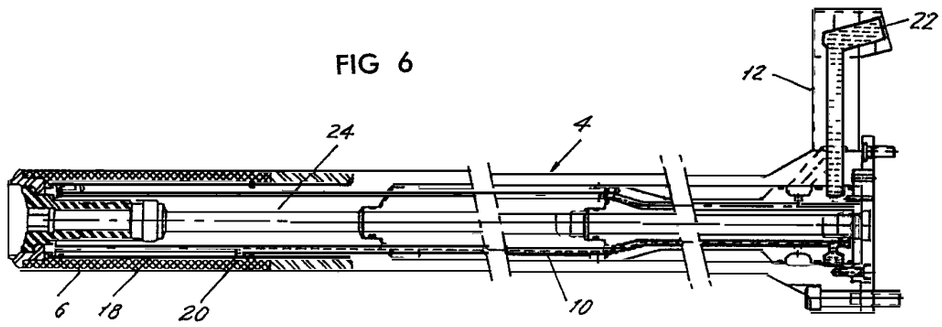
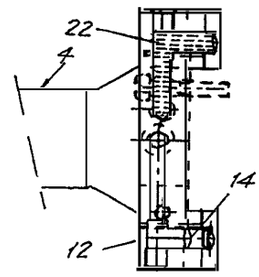



FIG 7



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# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US02/34895

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : B21D 37/16
US CL : 72/342.3
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 72/342.3

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | US 3,577,753 A (SHAH) 04 May 1971 (04.05.1971), whole document. | 1-8 |
| Y | US 5,678,442 A (OHBA et al.) 21 October 1997 (21.10.1997), Fig. 8 and column 2 lines 22-41. | 1-8 |
| Y | US 6,216,511 A (OHNISHI et al.) 17 April 2001 (17.04.2001), column 6, lines 28-30. | 1-8 |
| A | IT 499,298 A (CALMES) 10 November 1954 (10.11.1954), whole document. | 1-9 |

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 09 December 2002 (09.12.2002) | 23 DEC 2002 |
| Name and mailing address of the ISA/US<br>Commissioner of Patents and Trademarks<br>Box PCT<br>Washington, D.C. 20231<br>Facsimile No. (703)305-3230 | Authorized officer<br>Allen Ostrager<br>Telephone No. 703-308-3136 |

Stephen Marcus
Special Program Examiner
Group 3700

Form PCT/ISA/210 (second sheet) (July 1998)

US005678442A

# United States Patent [19]

Ohba et al.

[11] Patent Number: 5,678,442

[45] Date of Patent: Oct. 21, 1997

[54] EXTRUDER

[75] Inventors: Hiroyuki Ohba; Hideki Iwai, both of Yamaguchi, Japan

[73] Assignee: Ube Industries, Ltd., Ube, Japan

[21] Appl. No.: 656,523

[22] Filed: May 31, 1996

[30] Foreign Application Priority Data

| | | | |
|---|---|---|---|
| Jan. 27, 1995 | [JP] | Japan | 7-160888 |
| Aug. 29, 1995 | [JP] | Japan | 7-220131 |
| Oct. 31, 1995 | [JP] | Japan | 7-283510 |
| Dec. 8, 1995 | [JP] | Japan | 7-320649 |

[51] Int. Cl.[6] ..... B21C 27/00

[52] U.S. Cl. ..... 72/272; 72/273; 72/342.3

[58] Field of Search ..... 72/272, 273, 273.5, 72/270, 264, 342.2

[56] References Cited

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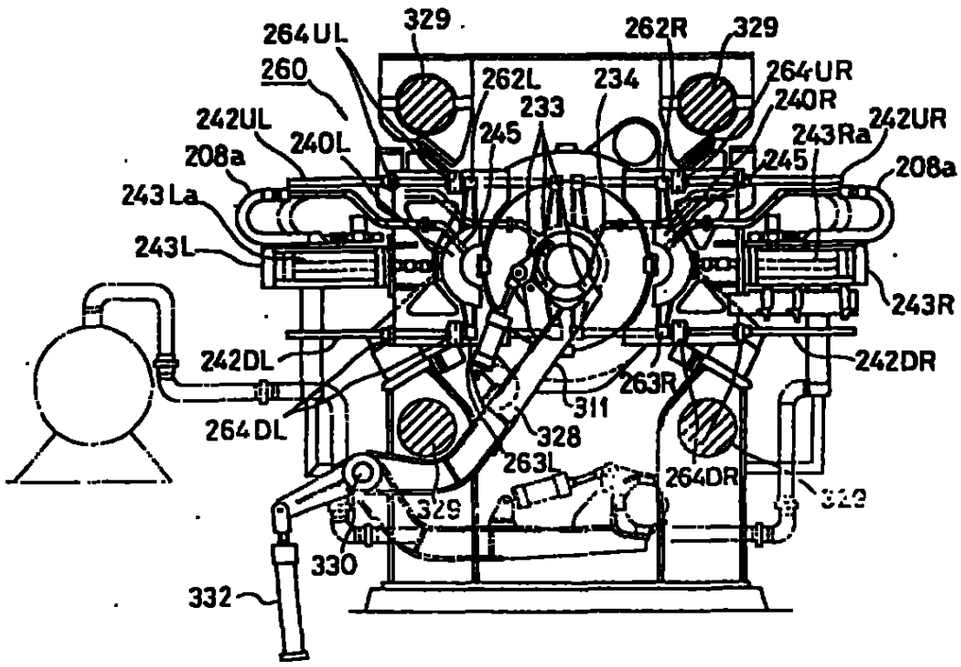
*Primary Examiner*—Lowell A. Larson
*Assistant Examiner*—Ed Tolan
*Attorney, Agent, or Firm*—Kanesaka & Takeuchi

[57] ABSTRACT

An extruder has a cylindrical container into which a billet is loaded; a two-piece seal block disposed on an end surface of the container at an extruding stem side; a vacuum deserating hole formed in the seal block; and a fixed dummy block, having an internal cooling function, fixed to an end of the extruding stem, wherein the seal block is allowed to be opened and closed in a direction perpendicular to the axial direction of the container and the seal block comes in close contact with an outer surface of the extruding stem and the end surface of the container when the seal block is closed.

19 Claims, 23 Drawing Sheets



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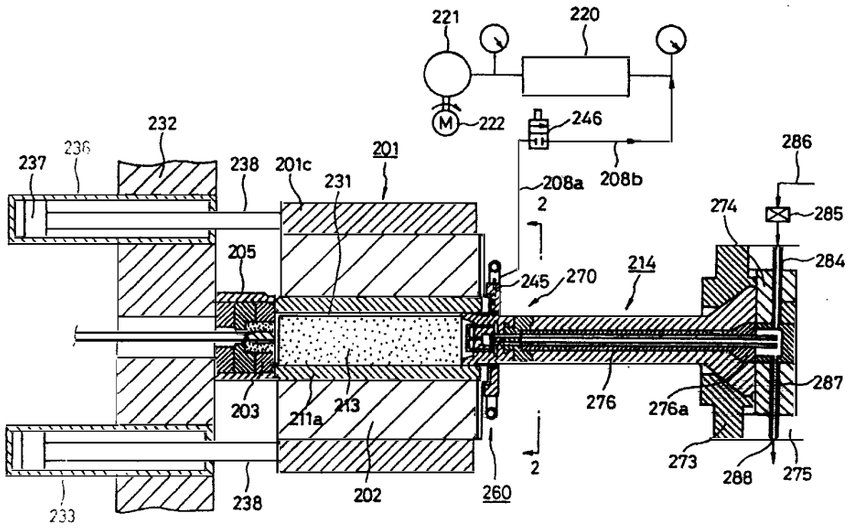
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Fig. 2

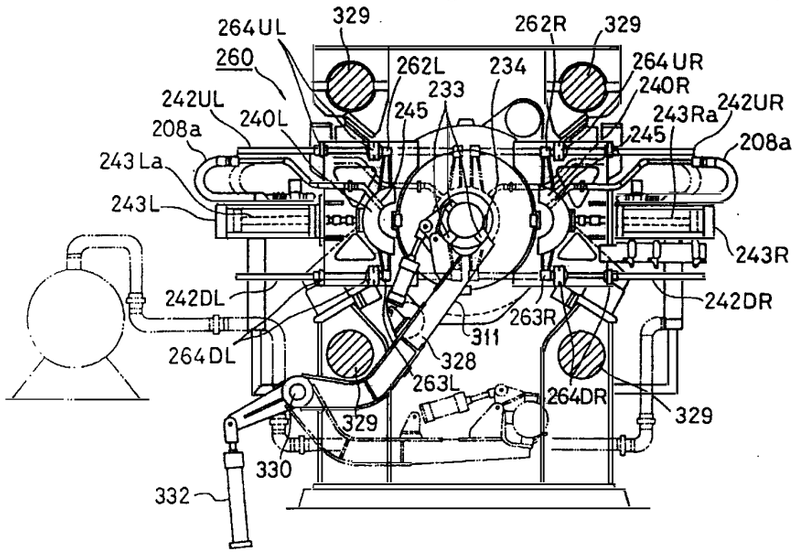
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Fig. 3

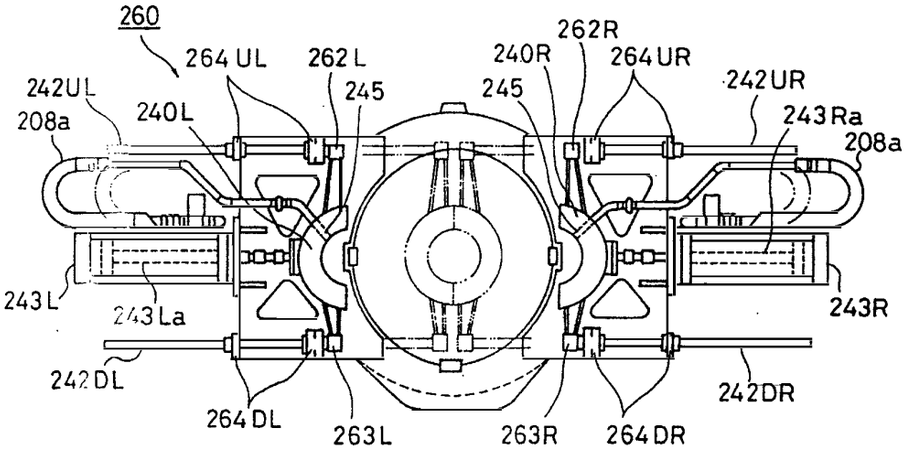
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Fig. 4

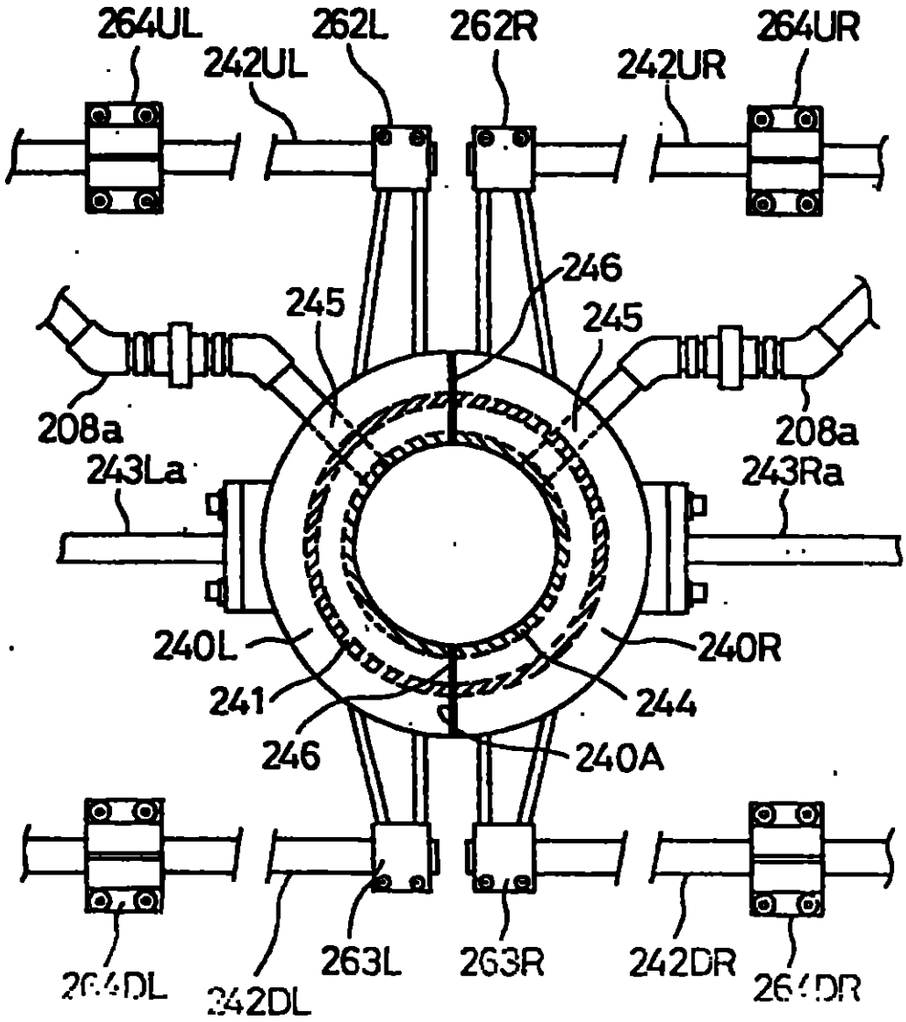
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Fig. 5A

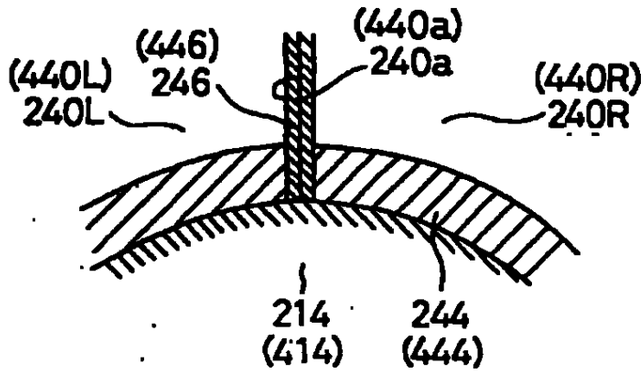
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Fig. 5B

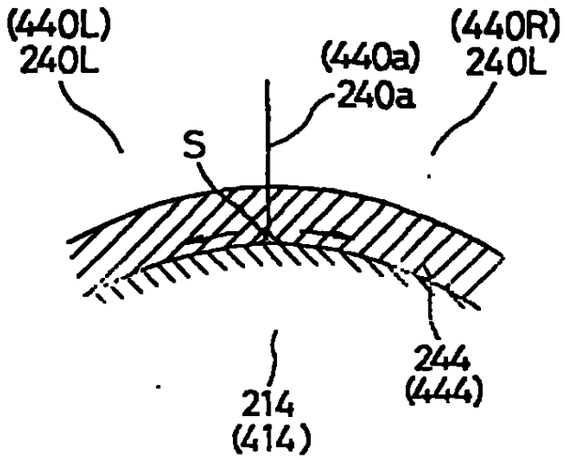
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Fig. 6A

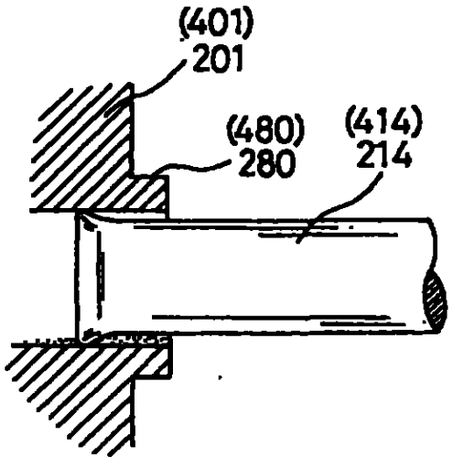
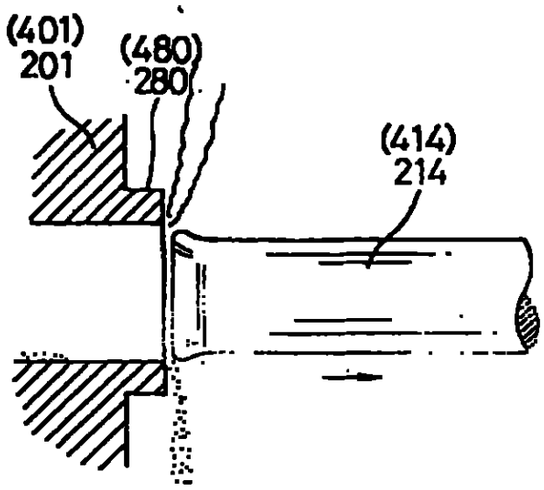



Fig. 6B



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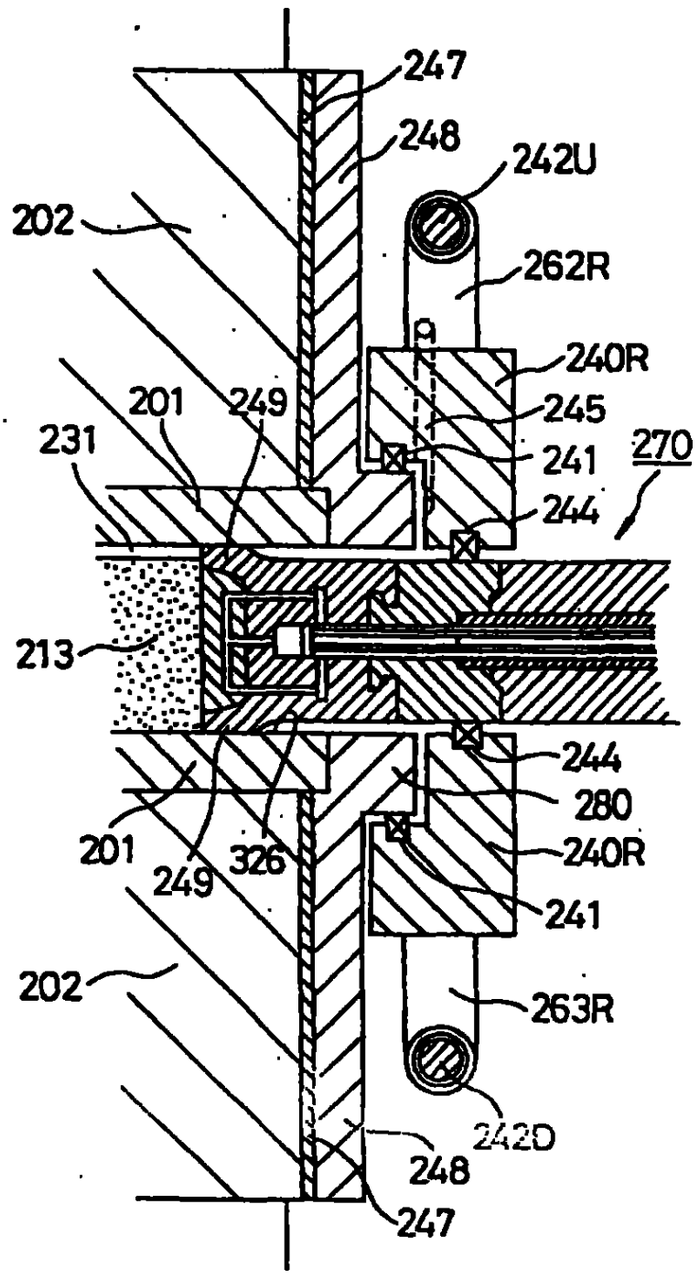
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Fig. 8

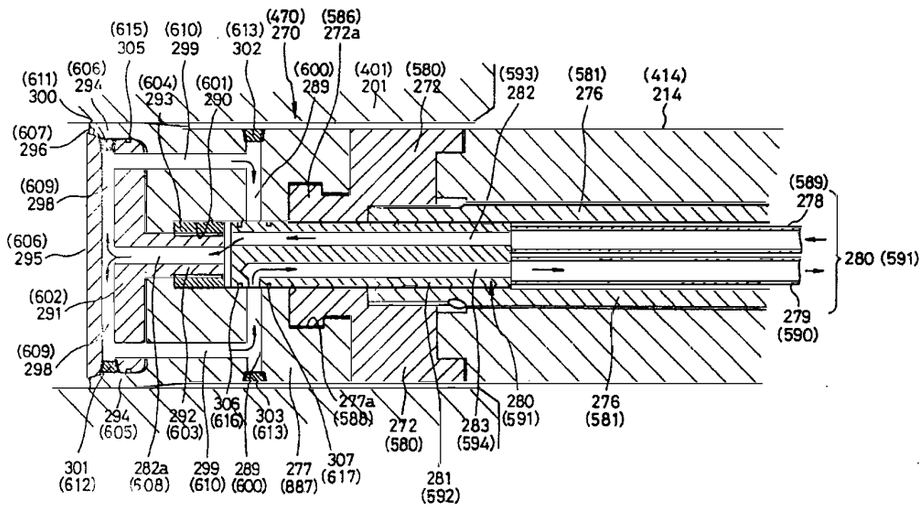
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Fig. 9

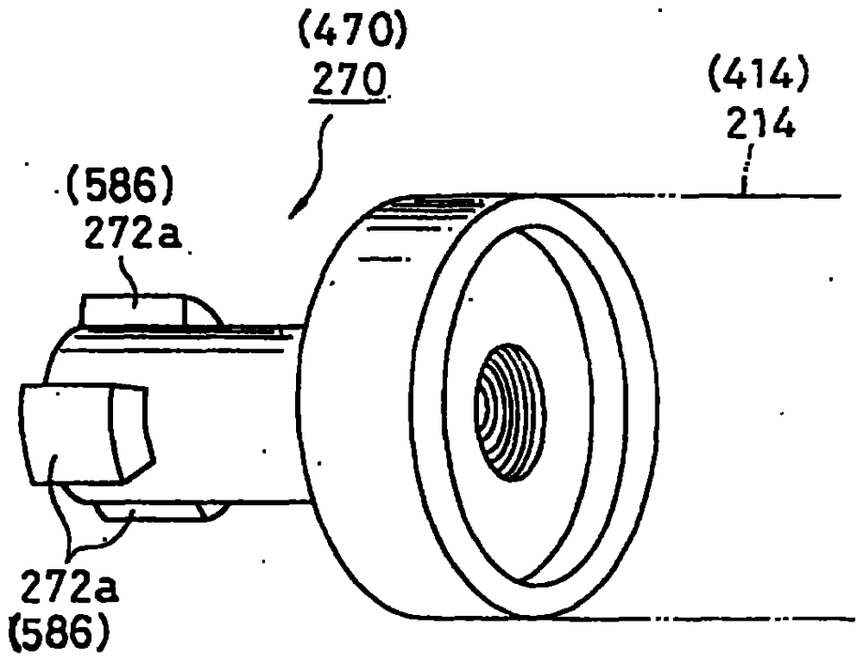

Fig. 10

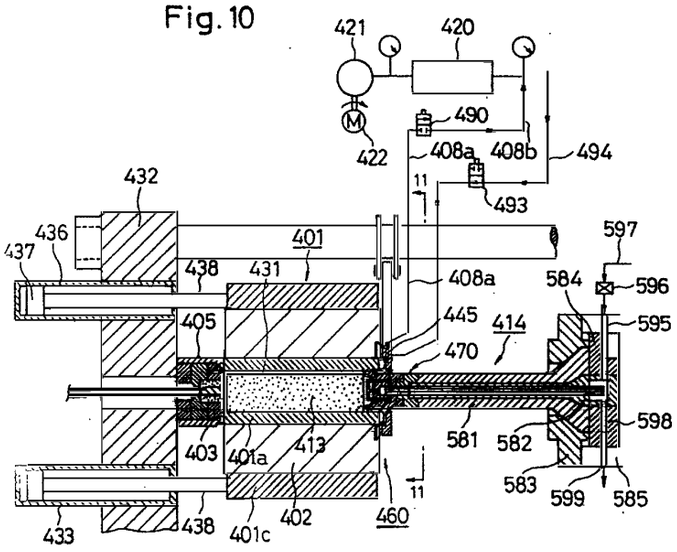
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Fig.11

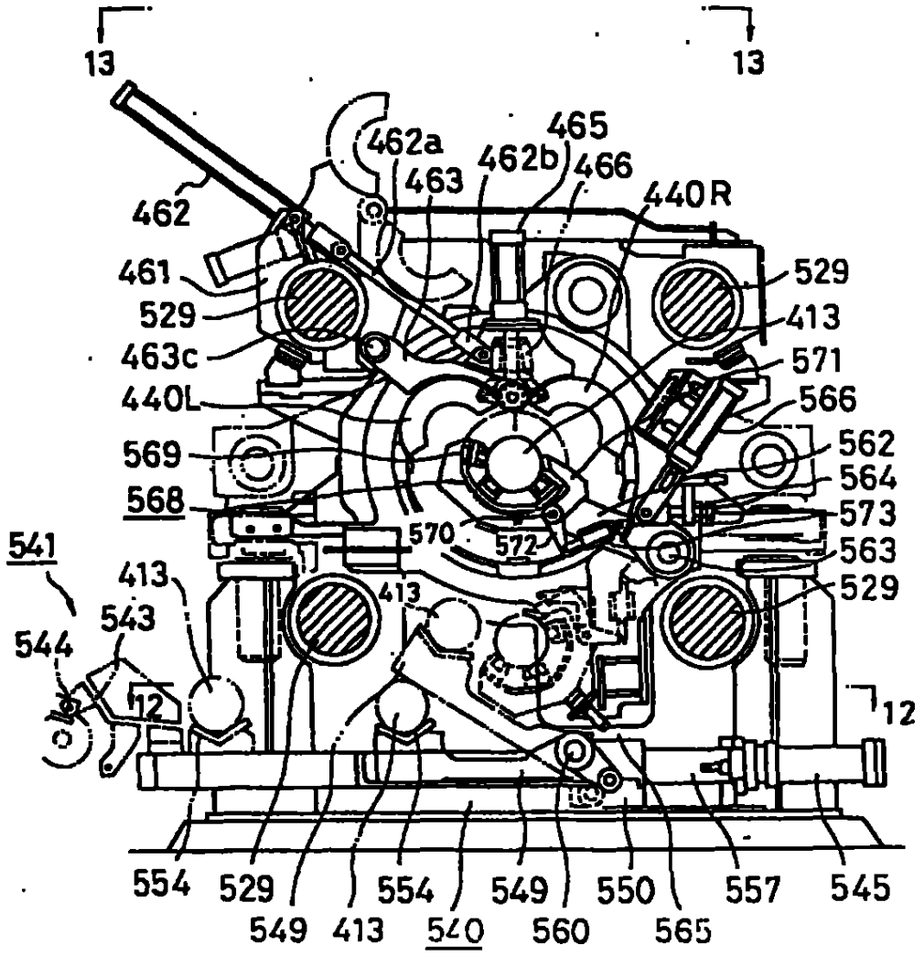
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Fig. 12

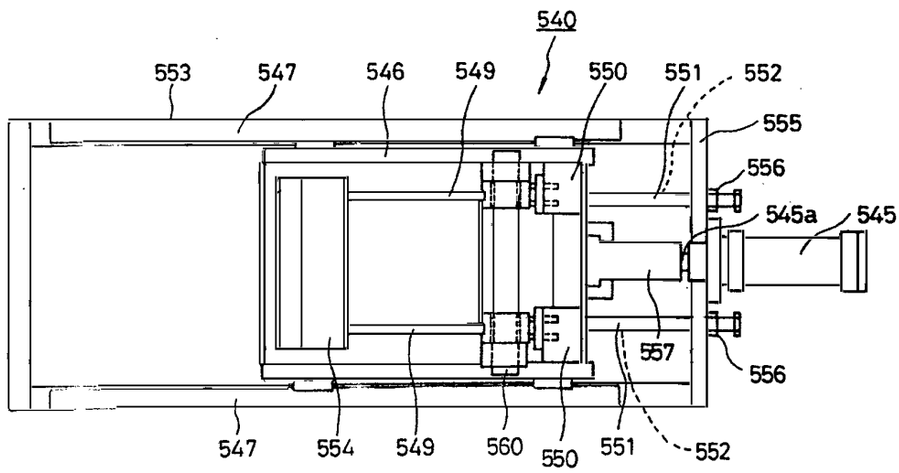
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Fig. 13

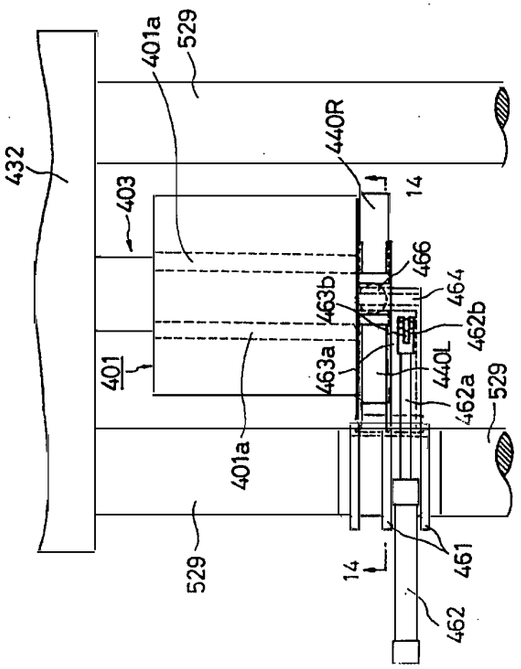
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Fig. 14

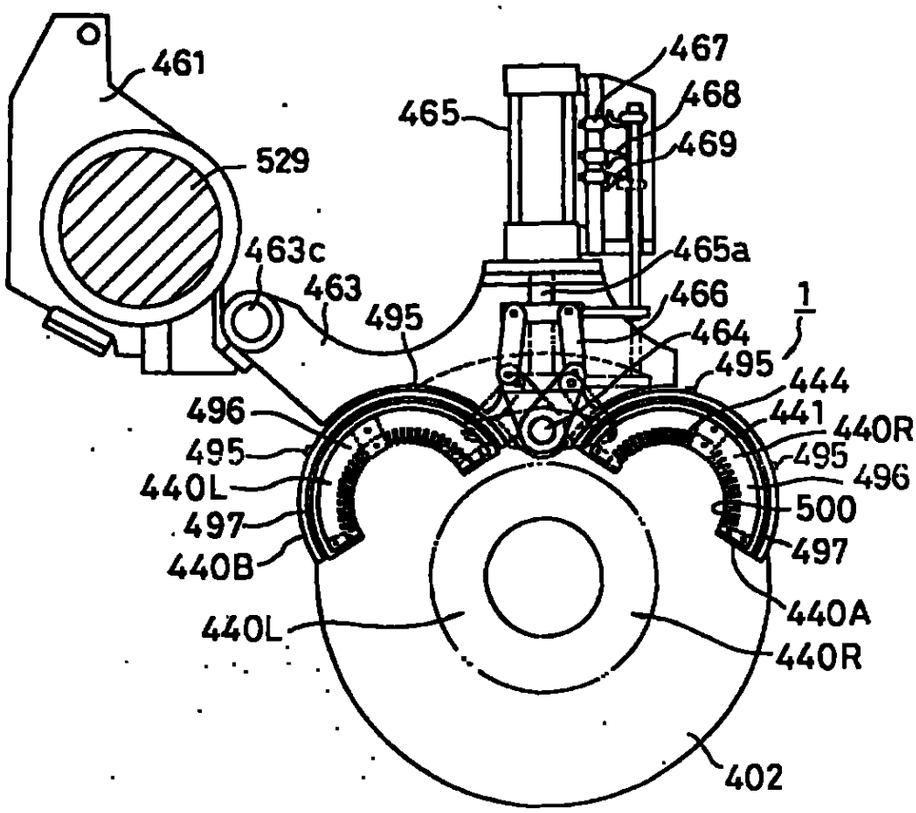
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Fig. 15

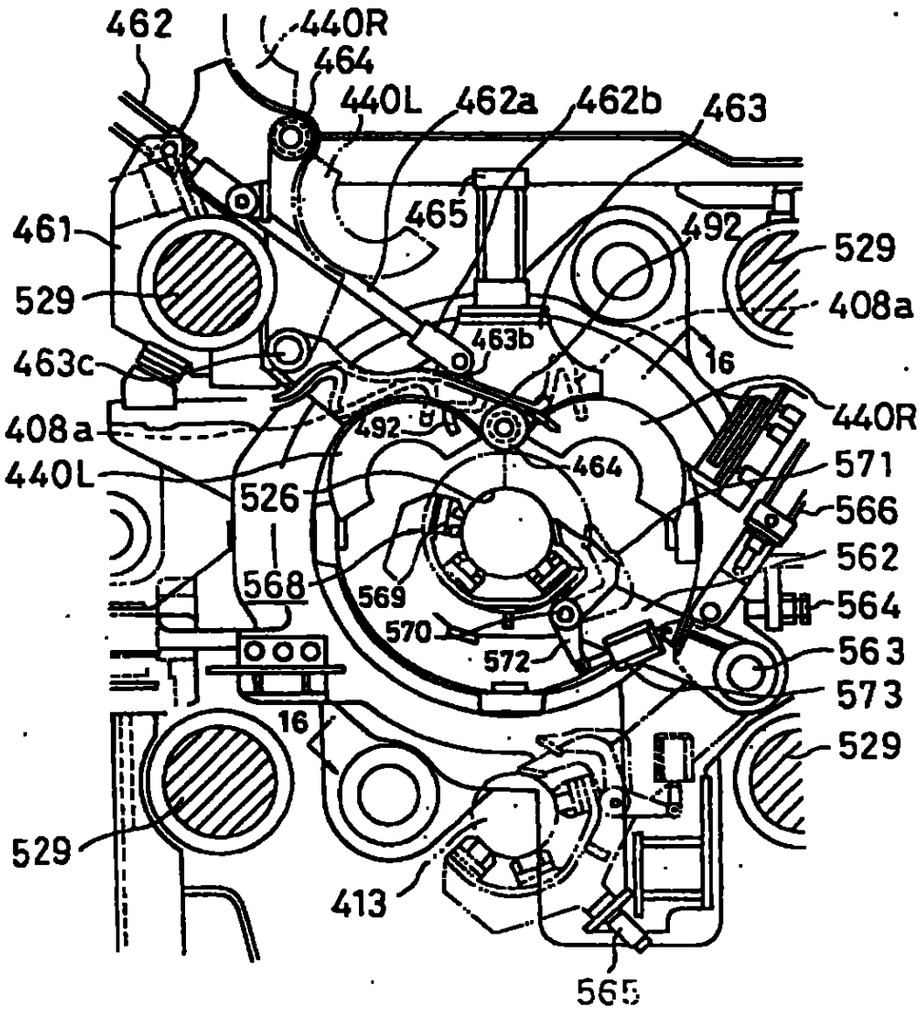
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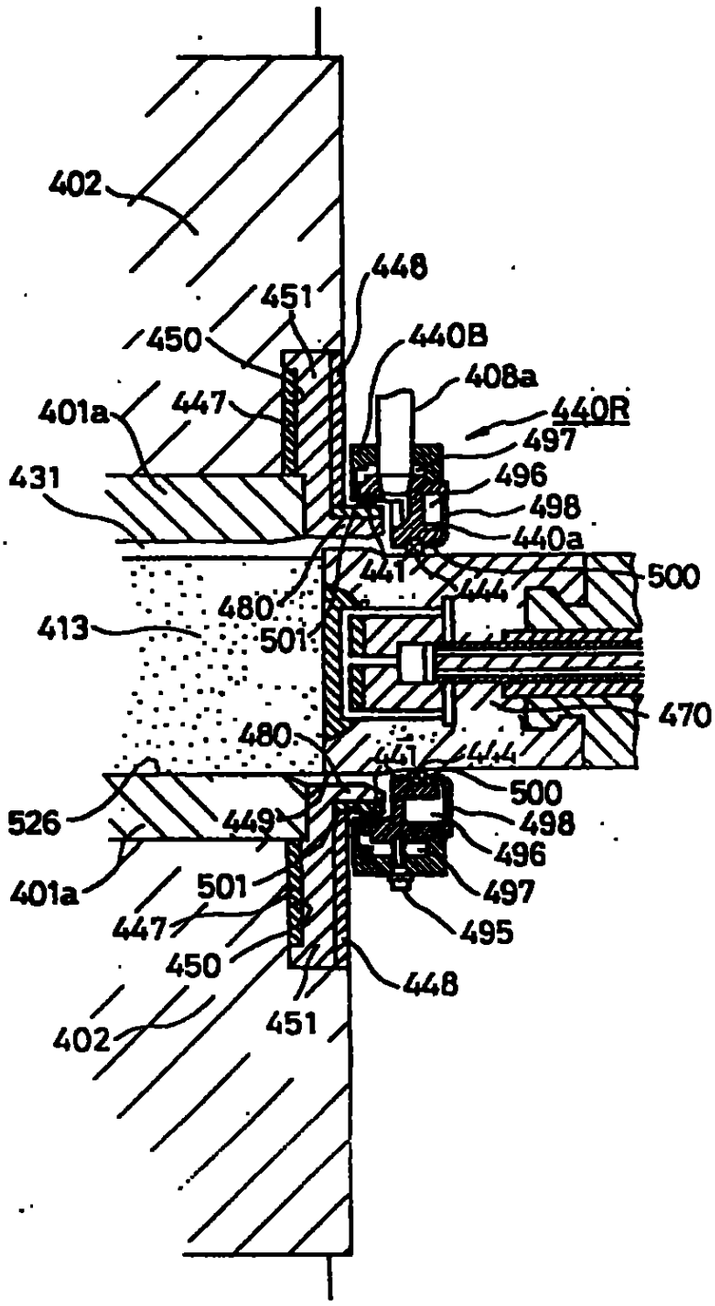
Fig. 16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480
413
501
470
480
441
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526
449
498
496
401a
501
497
447
495
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448
402
451

Fig. 17

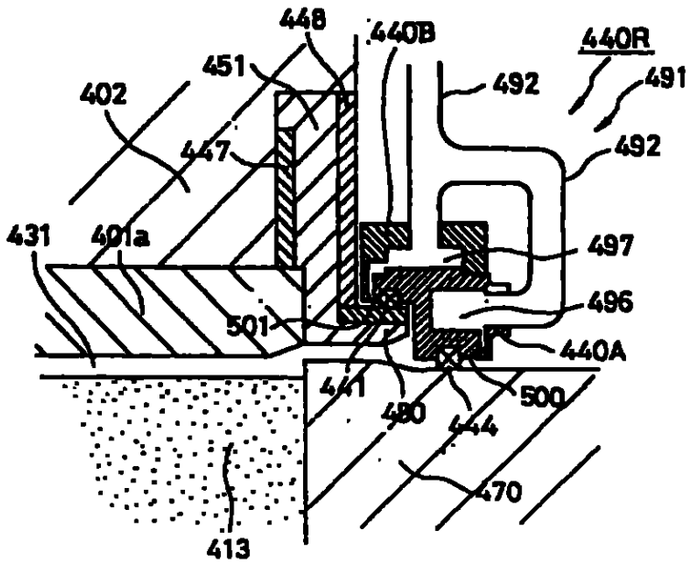

448
440B
440R
451
492
491
402
447
492
431
401a
497
496
501
440A
441
500
480
444
470
413

Fig. 18

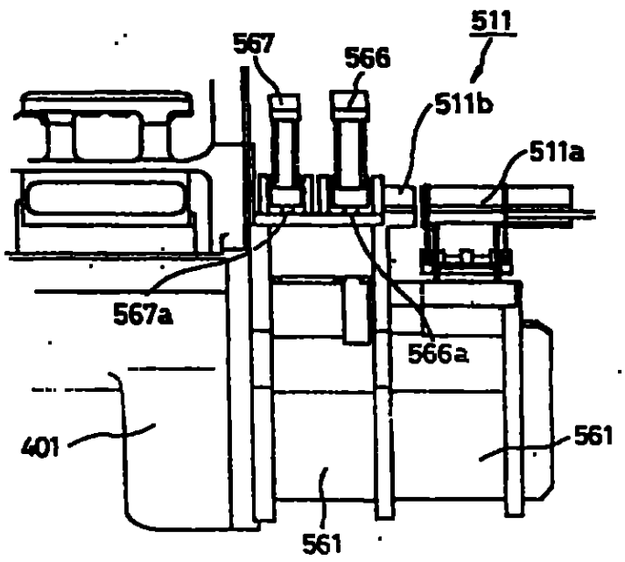

511
567
566
511b
511a
567a
566a
401
561
561

Fig. 19

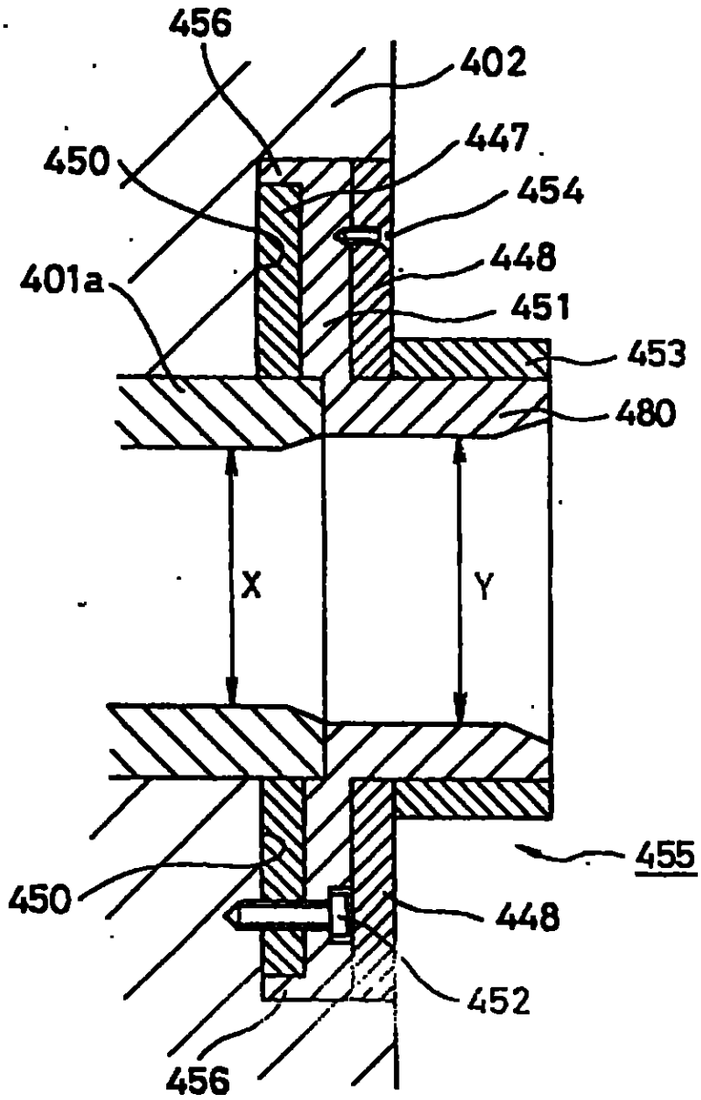


Fig. 20A

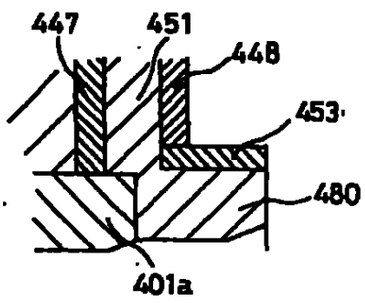



Fig. 20B

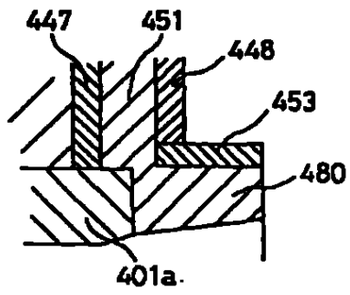



Fig. 20C

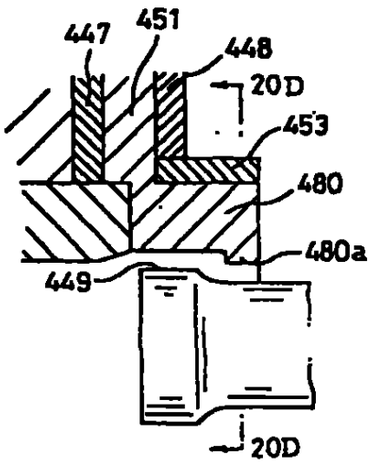



Fig. 20D

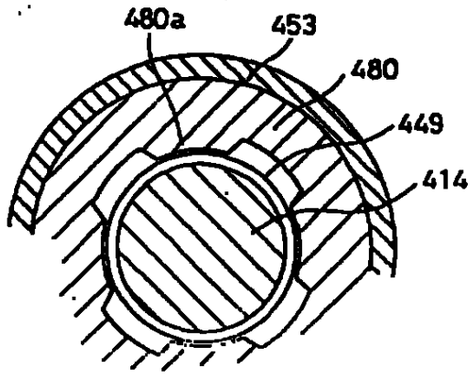


Fig.21A

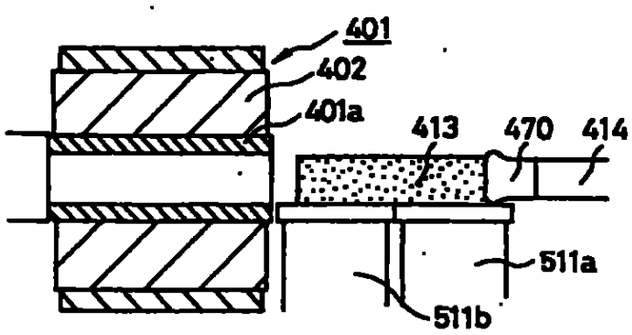



Fig.21B

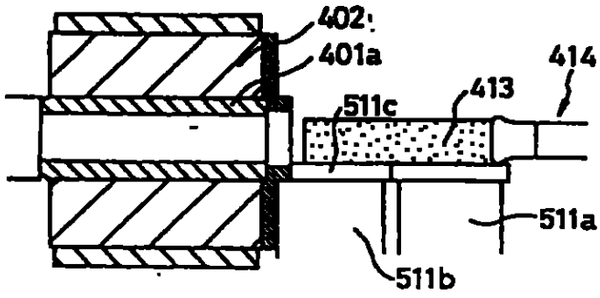



Fig.21C

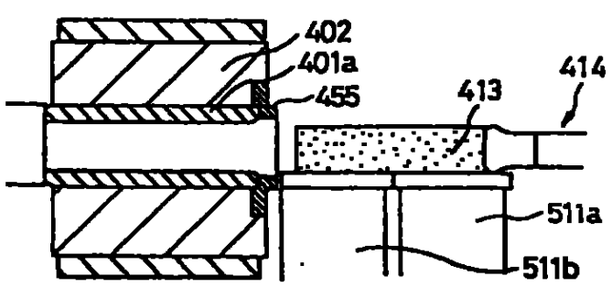



Fig.21D

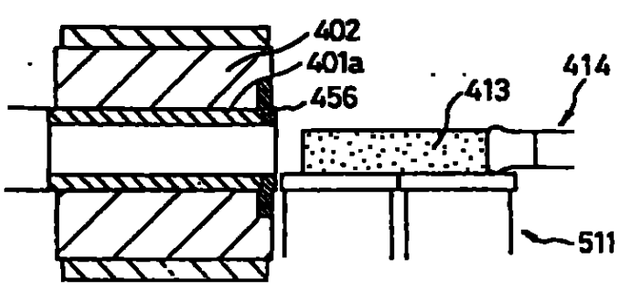



Fig.21E

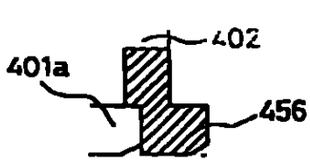


Fig. 22A

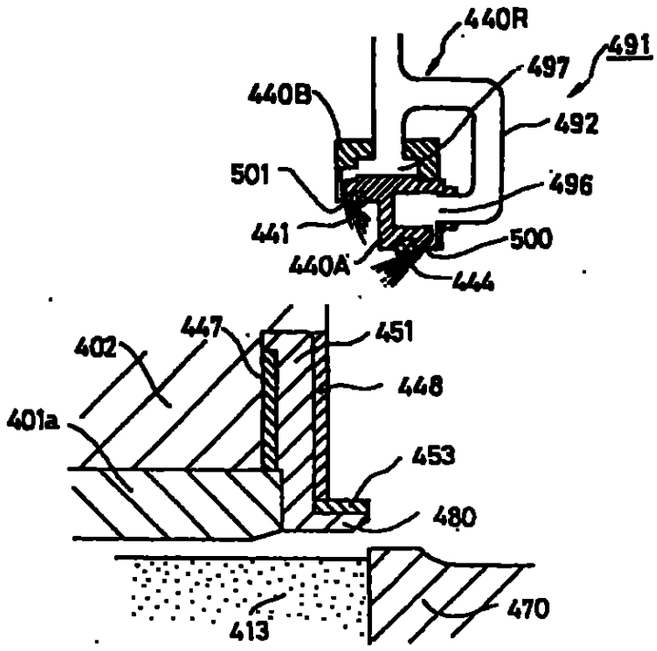



Fig. 22B

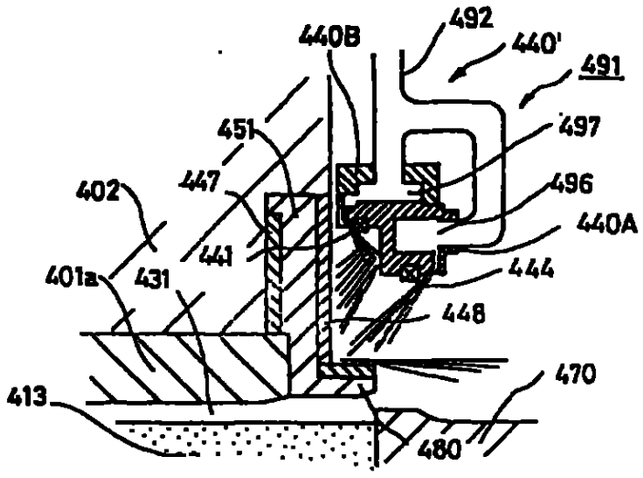


Fig. 23A

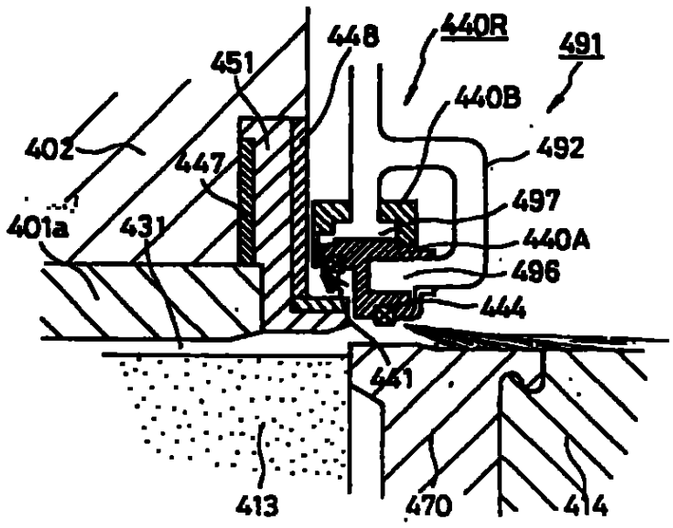
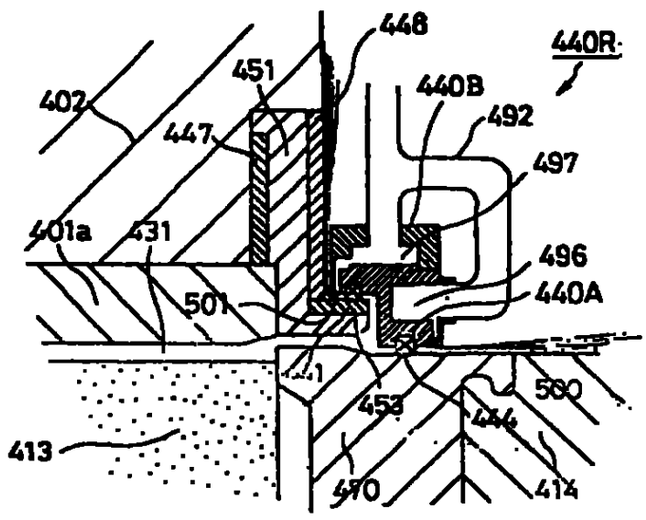



Fig. 23B



# EXTRUDER

## FIELD OF THE INVENTION AND RELATED ART STATEMENT

The present invention relates to an extruder, for extruding materials such as aluminum alloys by an extrusion press, which can eliminate air trapped between a container and a billet to the outside of the container until the billet is extruded from the inside of the container through a die, thereby reducing the idle time and providing an end product in which no blow hole of air is included.

After a billet is inserted into a container wherein inner diameter is slightly larger than that of the billet, the billet is pressed against the die with an extruding stem from the rear side of the container and is "upset" so that the billet is pressed to be deformed to compress air trapped between the container and the billet. For eliminating the compressed air, the extruding stem and the container are backed slightly and the compressed air is released into the atmosphere through a space formed between the die and the container. After that, the extrusion is started by advancing the container and the extruding stem once again. The breathing step for eliminating compressed air as mentioned above is referred to as a "verp cycle", which causes a waste of time in the extrusion cycle.

Moreover, this process remains air in a small space like a film at atmospheric pressure between the inner surface of the container and the outer surface of the billet when the container is pressed against the die after the verp cycle. That is, the sufficient deaeration can not be obtained by this process.

Then, there is a method as disclosed in Japanese Patent Publication No. 48-25315 to enable residual air to be easily and securely eliminated. In this process, the residual air is eliminated by providing metallic bellows to form a sealed chamber between a container and an extruding stem, sealing by metallic packing between one end of the bellows and the container and between the other end and the extruding stem by metallic packing, and pressing the metallic packing from the outside by a cylinder using air or fluid to eliminate air in the sealed chamber to the outside.

Japanese Unexamined Published Patent Application No. 52-47556 discloses a method of vacuum deaeration from a container through a space formed between a dummy block and the container with the inside of the container being sealed with sealing material, through a supporting member being sealingly in contact with the disc-like supporting plates arranged in suitable positions of an extruding stem with carbon sealant elastically by a spring disposed between the rear wall of the container and the supporting plates.

Moreover, Japanese Utility Model Publication No. 55-19605 discloses an extruder provided with a two-piece seal block allowed to open and close in a direction perpendicular to the axial direction of a container. In this extruder, the inner surface of the seal block comes into close contact with the outer surface of an extruding stem when the seal block closes.

Such a two-piece seal block opens and closes along a guide plate fixed to upper and lower portions of an end surface of the container at the extruding stem side. In addition, sealing members for sealing the container from the extruding stem are arranged between a cover plate and the seal block and between the extruding stem and the inner surface of the seal block, respectively. The container is provided with a deaerating groove at an upper portion thereof at the extruding stem side, thereby facilitating deaeration.



Furthermore, Japanese Unexamined Published Patent Application No. 5-245533 discloses a device comprising a rim, coming into contact with an end surface of a container at an extruding stem side, and an elastic member of telescopic type sealed by edges thereof which are slidable against the extruding stem to keep a hermetically sealed enclosure to be pressed against the end surface of the container over the full stroke of the extruding press device. Air in the container is vacuumed after sealed by bringing the rim into contact with the end surface of the container by stretching the elastic member of the telescopic type.

However, the methods disclosed in Japanese Patent Publication No. 48-25315 and Japanese Unexamined Published Patent Application No. 52-47556 have following problems. Since the methods are devised to completely eliminate the residual air in the container for the extrusion of the billet, the seal is accomplished by a flexible sealing device such as a metallic bellows expandable from the extruding stem side toward the rear end of the container. Therefore, the wider deaerating capacity is needed at the end of the container or there must be a space for rising of the billet leader, thereby increasing the idle time.

In addition to the insufficiency of air elimination, a main cause of blisters is the increased temperature of a fixed dummy block, which performs extrusion upon abutting against the billet, at the working surface side thereof. The temperature of the fixed dummy block is increased by heat retained in the billet heated upon continuously performing hot extrusions.

Once the temperature of the fixed dummy block at the working surface side is increased by heat received from the billet of aluminum alloy during the extrusion of the billet, impurities and/or blisters included in the outer portion of the billet, may flow into the inside of the end product by backward entrainment due to the metal flow. The entrainment of the impurities and/or blisters makes the yield of the end product lower. Particularly in case of extruding aluminum alloys, it has been observed from our experience that when the temperature of the working surface of the fixed dummy block is cooled around 250° C., the metal flow is prevented, thereby making occurrence of blisters difficult.

In Unexamined Published Utility Model Application No. 3-81214, a cooler for a fixed dummy block is disposed between a container and an extruding stem to spray coolant against an working surface of the fixed dummy block. It is, however, difficult to cool the working surface of the fixed dummy block to lower the temperature thereof from 450° C. to 200° C. through 300° C. during the stand-by period between the extrusion presses which is approximately 20 minutes so that a lot of blisters are entrained into the end product, thereby making the yield of the end product lower.

Additionally, there are the following problems related to Japanese Patent Publication No. 48-25315, Japanese Unexamined Published Patent Application No. 52-47556, and Japanese Unexamined Published Patent Application No. 5-245533 cited above.

(1) Since the flexible sealing device, such as a metallic bellows, a spring, or a telescopic elastic member, which is expandable from the extruding stem side toward the rear end of the container is used to seal the container to completely eliminate the residual air within the container for the extrusion of the billet, it necessitates a larger deaerating space and a longer deaerating time, and the atmosphere is easily entered into the container because of insufficient sealing, thereby the degree of vacuum lower.

(2) The sealing device is backed to a ram (a base portion of the extruding stem) side during loading the billet into the

container and then the inside of the container is sealed by advancing the sealing device after the billet is completely loaded by the forward movement of the extruding stem, thereby making the idle time longer for the operation of the sealing device.

(3) Since the flexible sealing device is stretched from the backmost position of the base of the extruding stem to the end surface of the container, the front portion of the seal device is deformed so as to make a space between the end surface of the container and the seal device, thereby deteriorating the sealing performance.

(4) It needs large pressure to press the sealing device from the rear side to the container so that the container comes in sufficiently contact with the end surface of the container, thereby making the structure complex.

(5) In a condition that the flexible sealing device is compressed at the backmost position, the extruding press device is longer than the conventional extruding stem (conventionally, the extending stem necessitates a length sufficiently for extruding the billet loaded in the container) for the size of the sealing device in the compressed state, thereby increasing the whole length of the extruding press and thus necessitating a wider area for installing the extruding press.

(6) According to Japanese Unexamined Published Patent Application No. 52-47556 or Japanese Unexamined Published Patent Application No. 5-245533, the sealing device moves relatively to the extruding stem with the sealing device being always in contact with the extruding stem, thereby wearing sealing materials and the contact surfaces between the sealing device and the extruding stem and decreasing their lives.

(7) In the case of (6), the front portion of the sealing device is deformed, so that the sealing device easily interfere with the extruding stem, thereby further decreasing their lives.

There are the following problems related to Japanese Utility Model Publication No. 55-19605.

i) The two-piece seal block opens and closes along the guide plate disposed on the end surface of the container. The sealing members disposed between the seal block and the guide plate receive heat from the container during opening and closing of the seal block, is exposed to high temperature (for example more than 300° C.) by holding heat in air heated in the container and moreover rubs against the guide plate, therefore significantly deteriorating the sealing members and decreasing the lives.

ii) When the extruding stem is backed to the original position after completion of extrusion of the billet, for scrapping off aluminum residues by the fixed dummy block fixed to the end of the extruding stem, the scrapped aluminum residues enter into a groove of the guide plate so that the seal block is difficult to open and close, thereby deteriorating sealing performance.

iii) Since the decreating groove is formed in the inner surface of the container, i.e. the upper portion of the inner surface of the container at the extruding stem side, such a container is not allowed to be used in a general purpose extruder because of the limitation so that the container must be exchanged with another one without decreating groove whenever used for another purpose, thereby taking a lot of time for exchanging containers.

iv) The container liner is exerted with large external force during upsetting the billet so that a portion where the decreating groove is formed is exerted with concentrated load, thereby decreasing the mechanical strength.

## OBJECT AND SUMMARY OF THE INVENTION

The present invention is achieved in consideration of the problems of prior art as mentioned above. It is an object of the present invention to provide an extruding cycle in which a container is sealed just before air in the container is completely eliminated before extruding a billet in the container, without a step of decreating before extruding the billet from a die, called as the vorp cycle. It is another object of the present invention to provide an extruder which cools a rear end portion of a billet to prevent the metal flow, thereby preventing residual air and impurities from entering into the billet and thus preventing the deterioration of the quality and yield of end products.

For achieving the objects mentioned above, according to a first aspect, an extruder comprises a cylindrical container into which a billet is loaded; a two-piece seal block disposed on an end surface of the container at an extruding stem side; a vacuum decreating hole formed in the seal block; and a fixed dummy block, having an internal cooling function, fixed to an end of the extruding stem, wherein the seal block is allowed to be opened and closed in a direction perpendicular to the axial direction of the container and the seal block comes in close contact with an outer surface of the extruding stem and the end surface of the container when the seal block is closed.

The billet in the container is pressed from the rear side against the die by the extruding stem so that the billet is squeezed and air trapped between the container and the billet is compressed. The compressed air must be vacuumed from the rear side of the container before the billet is squeezed from the die. In addition, air must be vacuumed from the container just before the end of the billet comes into contact with the die. According to the present invention, air in the container is forcibly vacuumed from the extruding stem side before the billet is compressed by the extruding stem, thereby omitting the step for eliminating compressed air, called as a breathing.

The fixed dummy block fixed to the working-side end of the extruding stem is cooled inside thereof before vacuuming the air from the container and then air in the container is vacuumed with the container being sealed by the seal block disposed on the end surface of the container at the extruding stem side to open and close in the direction perpendicular to the axial direction of the container so that air trapped between the container and the billet can be easily vacuumed as well as the metal flow of the billet is prevented, thereby significantly improving the yield of the end products without blister.

According to a second aspect, an extruder comprises a container having a container liner into which a billet is loaded; a ring-like protrusion disposed on an end surface of the container at an extruding stem side; and a two-piece seal block being opened and closed in a direction perpendicular to the axial direction of the extruding stem; wherein the seal block comes into close contact with an outer surface of the ring-like protrusion and an outer surface of the extruding stem at the same time when the seal block is closed. According to a third aspect, on the basis of the second aspect, the seal block is provided with a vacuum decreating hole for eliminating residual air in the container wherein the vacuum decreating hole is connected to a vacuum pump. According to a fourth aspect, on the basis of the second aspect, the seal block is provided with sealing material having heat resistance and resiliency attached to a contact surface of the seal block which comes into contact with each other when the seal block is closed. According to a fifth

aspect, on the basis of the second aspect, when the seal block is opened, the seal block can be moved not to interfere with a billet loader on which the billet to be loaded is placed and not to interfere with the exchange of the container.

The billet in the container is pressed from the rear side against the die by the extruding stem so that the billet is squeezed and air trapped between the container and the billet is compressed. The compressed air must be vacuumed from the rear side of the container before the billet is squeezed from the die. In addition, air must be vacuumed from the container just before the end of the billet comes into contact with the die. According to the present invention, the air in the container is forcibly vacuumed from the extruding stem side before the billet is compressed by the extruding stem, thereby omitting the step for eliminating compressed air, called as a buzzing.

Air in the container is vacuumed with the container being sealed by the seal block disposed on the end surface of the container at the extruding stem side to open and close in the direction perpendicular to the axial direction of the container so that air trapped between the container and the billet can be easily vacuumed as well as the metal flow of the billet is prevented, thereby significantly improving the yield of the end products without blister.

According to a sixth aspect, an extruder comprises a container having a container liner into which a billet is loaded; a ring-like protrusion disposed on an end surface of the container at an extruding stem side; a ring-like seal block comprising a pair of seal block pieces disposed above a portion, at the container side, of the extruding stem; and a hydraulic cylinder for opening and closing the seal block, wherein the seal block is opened and closed by swing-like motion in a direction perpendicular to the axial direction of the extruding stem, the seal block comes into contact with an outer surface of the ring-like protrusion and an outer surface of a fixed dummy block or the extruding stem at the same time through sealing members attached to a contact surfaces of the seal block pieces when the seal block is closed, and the seal block pieces are moved between a position where the seal block is closed and a backmost position where the seal block is opened by the rectilinear motion of a rod of the hydraulic cylinder.

According to a seventh aspect, on the basis of the sixth aspect, the seal block is provided with a vacuum deaerating hole for eliminating residual air in the container wherein the vacuum deaerating hole is connected to a vacuum pump through a pipe line.

According to an eighth aspect, on the basis of the sixth aspect, the fixed dummy block is provided with an internal cooler for cooling the fixed dummy block.

According to a ninth aspect, on the basis of the sixth aspect, the seal block is provided with a cooler for cooling the sealing member. According to a tenth aspect, on the basis of the sixth aspect, the ring-like protrusion is provided with a deaerating groove formed in an inner surface thereof at the extruding stem side, the deaerating groove being formed in a circular shape the inner diameter of which is larger than the outer diameter of the fixed dummy block fixed to an end of the extruding stem.

According to an eleventh aspect, on the basis of the sixth aspect, the seal block pieces are each structured to be separated into an inner seal block piece, positioned at an inner side of the seal block and having the sealing member, and an outer seal block piece, positioned outside the inner seal block piece to hold the inner seal block piece, wherein the inner seal block piece has a first coolant path formed radially and covered by a lid, a second coolant path between the inner seal block piece and the outer seal block piece, and gas outlets for spraying coolant to the sealing members and for blowing off sticks such as dusts and residues.

The extruder is provided with the ring-like protrusion, disposed on the end surface of the container at the extruding stem side, and rotational bases of the seal block pieces at the upper end surface of the container. The container is sealed by the seal block pieces, fixed to tips of swing arms extending from the rotational bases to allow the closing motion of the seal block in the direction perpendicular to the axial direction of the container. The ring-like protrusion is provided with the deaerating groove formed in the inner surface thereof at the extruding stem side. The deaerating groove is formed in a circular shape, the inner diameter of which is larger than the outer diameter of the fixed dummy block fixed to an end of the extruding stem so as to form a space between the inner surface of the ring-like protrusion and the outer surface of the fixed dummy block when the billet is loaded in the container by the extruding stem. Therefore, air trapped between the container and the billet is easily vacuumed, thereby significantly improving the yield of the end products without blister.

Moreover, the ring-like seal block is cooled while coolant passes through the coolant paths formed in the ring-like seal block. The ring-like seal block is provided with gas outlets for spaying the coolant to the sealing members and for blowing off sticks such as dusts and residues at the same time. The sealing members are cooled by the coolant spouted out from the gas outlets whenever the seal block is closed, thereby increasing the life of the sealing member. During closing the seal block, the gases spouted out from the gas outlets blow off aluminum residues, dusts and residues glued on the outer surface of the extruding stem or around the inner surface of the seal block, thereby keeping the higher sealing performance and performing the deaeration with higher degree of vacuum.

According to a twelfth aspect, an extruder comprises a container having a container liner into which a billet is loaded; a ring-like protrusion disposed on an end surface of the container at an extruding stem side; a ring-like seal block being opened and closed in a direction perpendicular to the axial direction of the extruding stem, wherein when the seal block is closed, the seal block comes into contact with an outer surface of the ring-like protrusion and an outer surface of a fixed dummy block or the extruding stem through a sealing member attached to contact surface of the seal block; and a cooler disposed in the seal block for cooling the sealing member. According to a thirteenth aspect, on the basis of the twelfth aspect, the seal block is provided with seal block pieces pivotally mounted for closing and opening the seal block, and the seal block pieces pivot so as to clamp the outer surface of the ring-like protrusion and the outer surface of the fixed dummy block or the extruding stem through the sealing members when the seal block is closed.

According to a fourteenth aspect, on the basis of the twelfth aspect, the extruder further comprises a guide ring and guide rods. The guide rods are disposed above and under the seal block, respectively. The guide rods can move linearly and sidewardly (horizontally), and the rods can slide on the guide ring. Two seal blocks are moved apart from and getting closer to each other by the guide rod and the cylinder.

According to a fifteenth aspect, on the basis of the twelfth or thirteenth aspect, the fixed dummy block is provided with an internal cooler for cooling the fixed dummy block.

According to a sixteenth aspect, on the basis of the twelfth aspect, the seal block is provided with a vacuum deaerating

hole for eliminating residual air in the container wherein the vacuum deaerating hole is connected to a vacuum pump through a pipe line.

According to a seventeenth aspect, on the basis of the twelfth aspect, the ring-like seal block is provided with gas outlets inside thereof for spraying coolant to the sealing members and for blowing off sticks such as dusts and residues.

The fixed dummy block fixed to the working-side end of the extruding stem is cooled inside thereof before vacuuming air from the container. Air in the container is vacuumed before the billet is compressed between the extruding stem and the die, with the container being sealed by the seal block pieces by coming into close contact with the ring-like protrusion and the extruding stem at the same time. The seal block pieces are fixed to the tips of the swing arms extending from the rotating bases disposed on the upper end surface of the extruding stem side extruding stem side to allow the closing motion of the seal block in the direction perpendicular to the axial direction of the container. Therefore, air trapped between the container and the billet can be easily vacuumed, thereby significantly improving the yield of the end products without blister.

Moreover, the ring-like seal block is cooled while coolant passes through the coolant paths formed in the ring-like seal block. The ring-like seal block is provided with gas outlets for spaying the coolant to the sealing members and for blowing off sticks such as dusts and residues at the same time. The sealing members are cooled by the coolant spouted out from the gas outlets whenever the seal block is closed, thereby increasing the life of the sealing member. During closing the seal block, the gases spouted out from the gas outlets blow off aluminum residues, dusts and residues glued on the outer surface of the extruding stem or around the inner surface of the seal block, thereby keeping the higher sealing performance and performing the deaeration with higher degree of vacuum.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a system diagram of one preferred embodiment according to the present invention;

FIG. 2 is a perspective sectional view taken along a line 2—2 of FIG. 1;

FIG. 3 is an enlarged partial sectional plan view of Fig. 2;

FIG. 4 is a front view of a seal block;

FIGS. 5A and 5B are views illustrating comparison between a case of a two-piece seal block in which both surfaces are glued with sealing materials, respectively, and a case without sealing material;

FIGS. 6A and 6B are views for explaining the conditions of scrapping off aluminum residues glued on the inner surface of a container;

FIG. 7 is an enlarged sectional view of a seal block;

FIG. 8 is a sectional view of an extruding stem having an internal cooler;

FIG. 9 is a perspective view of a bayonet block;

FIG. 10 is a system diagram of an extruder provided with a preferred deaerator according to the present invention;

FIG. 11 is a front view taken along a line 11—11 of FIG. 10;

FIG. 12 is a front view taken along a line 12—12 of FIG. 11;

FIG. 13 is a plan view taken along a line 13—13 of FIG. 11;

FIG. 14 is a front view taken along a line 14—14 of FIG. 13;

FIG. 15 is an enlarged partial sectional plan view of a seal block;

FIG. 16 is a sectional view taken along a line 16—16 of FIG. 15;

FIG. 17 is an enlarged partial sectional plan view of a cooler mounted on the seal block;

FIG. 18 is a front view of a billet loader;

FIG. 19 is a partially sectional view of a protrusion;

FIGS. 20A, 20B, 20C and 20D are enlarged sectional views illustrating configurations of the inside of the protrusion;

FIGS. 21A through 21E are views for explaining the mounting structure of a heat insulating seal block;

FIGS. 22A and 22B are views illustrating the opening and closing of the seal block and the condition of spraying coolant; and

FIGS. 23A and 23B are views illustrating an operation following FIGS. 22A and 22B.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, a first embodiment of an extruder according to the present invention will be described with reference to the attached drawings.

FIG. 1 is a system diagram of a first the second embodiment, FIG. 2 is a perspective view taken along a line 2—2 of FIG. 1, FIG. 3 is an enlarged partial sectional plan view of FIG. 2, FIG. 4 is an enlarged partial front view of a seal block, FIGS. 5A and 5B are views illustrating comparison between a case of a two-piece seal block in which both surfaces are glued with sealing materials, respectively, and a case without sealing material, FIGS. 6A and 6B are views for explaining the conditions of scrapping off aluminum residues glued on the inner surface of a container 201.

As shown in FIG. 1, an end platen 232 is provided with container cylinders 233 for allowing the sliding of a container 201 comprising a container liner 211a, a container tier 212 and a container holder 211c. Reference numeral 236 designates a cylinder tube which is a part of a cylinder body, 237 designates a piston, and 238 designates a piston rod.

Reference numeral 203 designates a die wherein an outer surface is slidably supported to the inner surface of a die ring 205. Reference numeral 231 designates a space, as a deaeration space to be deaerated, between the inner surface of the container and the outer surface of the billet 213.

An extruding stem 214 for extruding a billet 213 is provided with a fixed dummy block 270 at the tip end thereof which is possible to be in close contact with the inner surface of the container 201.

According to this embodiment, a vacuum aspirator 260 for aspirating residual air from the deaeration space 231 will be now described.

The vacuum aspirator 260 for deaerating the deaeration space 231 from the extruding stem 214 side in the container 201 is arranged on an end surface of the container 201 at the extruding stem 214 side as shown in FIG. 2 and FIG. 3. A ring-like seal block 240 of which front view is formed in a doughnut-like configuration is disposed on the end surface of the container 201 at the extruding stem 214 side. The seal block 240 is divided into seal block pieces 240R, 240L of which rear ends are fixed to tips of piston rods 243Ra, 243La, respectively. The piston rods 243Ra, 243La are slidably inserted into a pair of cylinders 243 (43R, 43L), respectively.

According to the sliding of the piston rods 263Ra, 263La, the seal block pieces 246R, 246L move to open or close the seal block 240 in a direction perpendicular to the axial direction of the container 201 along guide rods 262U (262UR, 262UL) and 262D (262DR, 262DL) which are disposed above and under the seal block 240, respectively.

The seal block pieces 246R, 246L are provided with a pair of upper guide legs 262 (262R, 262L) facing each other, respectively, disposed on the upper surfaces of portions near contact surfaces 240A thereof. The guide rod 262U (262UR, 262UL) are fixed to upper guide legs 263 (263R, 263L) and inserted into through rings 264 (264UR, 264UL) to allow the opening and closing of the seal block 240.

On the other hand, the seal block pieces 246R, 246L are also provided with a pair of lower guide legs 263 (263R, 263L) facing each other, respectively, disposed on the lower surfaces of portions near contact surfaces 240A thereof. The guide rod 262D (262DR, 262DL) are fixed to lower guide legs 263 (263R, 263L) and inserted into through rings 264 (264DR, 264DL) to allow the opening and closing of the seal block 240.

For preventing air infiltration between the contact surfaces 240A of the seal block pieces 246R 246L when the seal block 240 is closed as shown by chain lines in FIG. 4, the contact surfaces 240A are provided with sealing members 246 (sheet-like sealants) attached thereon.

For example, the sealing members 246 are preferably sponge-like sealants, having heat resistance and resiliency, made of silicon rubber or fluoro-rubber.

When the seal block 240 is closed, the seal block 240 comes into sealing contact with a protrusion 280 (described later) through the sealing members 246 attached to the contact surfaces 240A of the seal block pieces 246R, 246L and sealing members 241 disposed on the inner surfaces of the seal block pieces 246R, 246L and comes into sealing contact with an outer surface of the extruding stem 214 through sealing members 244.

Among the sealing members 241, 244, 246, the sealing members 241 and 244 are preferably made of a heat resistant and high deformable material, such as relatively hard string-like silicone rubber and string-like fluoro-rubber.

On the other hand, the sealing members 246 are preferably made of a soft sponge-like rubber by comparison with the sealing members 241, 244, for example, heat resistant sponge-like material such as sponge-like silicone rubber sheet and sponge-like fluoro-rubber sheet.

Particularly, when the seal block 240 is closed relative to the extruding stem 214, the sealing members 244 are pulled in a direction of arrow because of the friction between the outer surface of the extruding stem 214 and the sealing members 244 as shown in FIG. 5B, thereby causing a space S between ends of the contact surfaces 240A.

In case where the sealing members 246 of sponge-like soft rubber (each 3 mm in thickness) are attached to the contact surfaces 240A of the seal block pieces 246R and 246L as shown in FIG. 5A, the sealing members 246 are compressed when the seal block 240 is closed and free ends of the sealing members 246 are about to project toward the extruding stem, thereby preventing the aforementioned space S. This effect is common to the sealing members 241. That is, a space on an outer surface of the protrusion 280 can be prevented by the sealing member 241.

When the seal block pieces 246R, 246L return to the backmost positions thereof as shown by solid lines in FIG. 2, a billet loader 311 (described later) can move out and in with the billet 213 placed thereon.

The seal block pieces 246R, 246L are each provided with a deserting hole 245 which is connected to an end of a flexible pipe line 286a, the other end of which is connected to a fixed pipe line 286b through an electromagnetic switch valve 246. The fixed pipe line 286b is connected to a vacuum tank 220.

Reference numeral 247 designates an insulator for preventing heat for heating the container 201 from traveling to the vacuum aspirator 268. The insulator 247 is provided with a heat insulating plate 248 disposed the upper surface thereof. The seal block pieces 246R, 246L is movable between the backmost positions and the forward-most positions, where the seal block is closed, without friction with the insulating plate 248.

The insulating plate 248 is provided with the protrusion 280, a front surface of which is formed in a ring-like configuration in a position corresponding to a container liner 201a. When the seal block 240 is closed, the protrusion 280 comes in sealing contact with the seal block 240 through the sealing members 241. Reference numeral 221 designates a vacuum pump and 222 designates a motor.

Another one of main features of the present invention is that there is no cover plate nor guide rail for the close motion of the seal block 240. This is because the seal block 240 is opened with the guide rods 262U, 262D being guided by the through rings 264 (264UR, 264UL, 264DR, 264DL).

The above structure facilitates the exchange of the container tire 202 and the container liner 211a and does not deteriorate the sealing performance because in case of scrapping off aluminum residues glued on the inner surface of a container liner 211a by the outer surface of the fixed dummy block 270 when the extruding stem 214 returns to the original position after extruding the billet 213, the scrapped aluminum residues just fall down from the edge of the inner surface of the protrusion 280 as shown in FIG. 6A and FIG. 6B, not enter into a groove of the guide plate as the prior art which causes hinder to the close motion of the seal block 240.

A billet loader 311 comprises a No. 1 billet loader and a No. 2 billet loader for supplying the billet 213 as an extrusion material to a billet loading opening 326 by clamping the billet 213, sent by a billet carrier (not shown) disposed at either side of the extruder, one by one, and lifting the billet 213 to the level of the billet loading opening 326.

The No. 1 billet loader and the No. 2 billet loader have the same structure.

The billet 213 is supplied below the container 201 by the billet carrier (not shown) one by one and then carried to the billet loading opening 326 with the billet 213 being clamped by the billet loader 311. Therefore, the billet loader 311 is disposed to face the billet carrier and is provided with a swing arm 328 which is pivotable along a plane perpendicular to the extruding axis of the extruder.

One end of the swing arm 328 is pivotally fixed to a central shaft 330 disposed outside a lower tight rod 329 of the extruder. The swing arm 328 is bent in a V-like shape with a high angle to prevent interference with the tight rod 329 during swinging and extends from a position below the lower tight rod 329 toward an upper portion of the container 201. The other end of the swing arm 328 travels from the board (not shown) of the billet carrier to the billet loading opening 326 and vice versa by the pivotal movement of the swing arm 328.

The swing arm 328 is connected to a hydraulic cylinder 332 which drives the swing arm 328 to pivot by its rectilinear motion.

The swing arm 328 is provided with a billet holder 233 for clamping the billet 213 placed on the other end thereof.

The billet holder 234 is provided with plates 334 for supporting the bottom of the billet 213 in a loading position.

As for the structure of the extruding stem 214, there are two cases: where the fixed dummy block 270 and the extruding stem 214 are connected through a bayonet block 272 as shown in FIG. 8 (hereinafter referred as "bayonet connection") and where the fixed dummy block 270 is directly connected to the extruding stem 214 by screwing.

First, the case of bayonet connection will be described as a typical structure.

In FIG. 8, reference numeral 201 designates the container, 214 designates the extruding stem, 270 designates the fixed dummy block of a fixed type which is fixed to the front surface of the extruding stem 214 and slidably disposed in the container 201. The rear end of the extruding stem 214 is fixed to a cross head 275 through a stem holder 273 and a pressure ring 274 as shown in FIG. 1.

The bayonet block 272 is disposed on the front surface of the extruding stem 214. A distal end of a connection rod 276 is screwed into the rear half of the bayonet block 272 so that the connection rod 276 is attached to the bayonet block 272. The connection rod 276 has a large-diameter portion 276a at the rear end thereof as shown in FIG. 1. The large-diameter portion 276a is fixed to a hole formed in the rear end portion of the extruding stem 214 so that tapered surfaces therebetween are engaged each other.

The front half of the bayonet block 272 has a structure of a bayonet type and is provided with, for example, three protrusions 272a disposed at equal spaces.

On the other hand, a dummy boss 277 is provided with concavities 277a disposed at equal spaces to engage the protrusions 272a. Installing the dummy boss 277 to the bayonet block 272 is securely and quickly accomplished by engaging the protrusion 272a of the bayonet block 272 with the concavities 277a of the dummy boss 277 and rotating the dummy boss 277 about 60 degree.

The connection rod 276 is provided with a through hole extending in the axial direction, in which a feed water pipe 278 and a drain pipe 279 are disposed. The feed water pipe 278 and the drain pipe 279 constitute a cooling pipe 280. Each one end of the feed water pipe 278 and the drain pipe 279 is secured to each of holes 282, 283 of a cooling pipe end block 281 by welding and each of the other ends extends to the inside of the pressure ring 274.

The end of the feed water pipe 278 is connected to a cooling water pump (not shown) through a path 284 of a pipe in the pressure ring 274, a valve 285, and a pipe line 286. The end of the drain pipe 279 is connected to a drain port 288 through a path 287 of a pipe in the pressure ring 274. There is a slight space between the inner surface of the extruding stem 214 and the outer surface of the connection rod 276 to keep the flexibility of the axis of the connection rod 276. There is also slight spaces between the inner surface of the connection rod 276 and the outer surfaces of the feed water pipe 278 and the drain pipe 279 not to directly cool the connection rod 276. Additionally, there is also a slight space between the inner surface of the connection rod 276 and the cooling pipe end block 281 to keep the flexibility of the axis of the connection rod 276.

In this case, since the feed water pipe 278 and the drain pipe 279 are inserted into the through hole formed in the connection rod 276, the connection rod 276 is not directly cooled and the temperature difference between the extruding stem 214 and the connection rod 276 is therefore small so as not to impair the flexibility of the axis of the fixed dummy block 270.

The hole 282 extends over the cooling pipe end block 281. The front end of the hole 283 is connected to a hole 289 allowing the outward flow through a cooling pipe end block 281.

The dummy boss 277 is provided with a central through hole 290 into which a small cylindrical protrusion 292 formed in a middle portion of a core block 291 is inserted. The small cylindrical protrusion 292 comes in tight contact with the dummy boss 277 by engaging a connection nut 293 to a screw thread formed in the protrusion 292 from the rear side of the dummy boss 277 and screwing up the connection nut 293.

The dummy boss 277 is provided with a cylindrical outer ring 294 integrally fixed to the front end periphery thereof. There is a space between the rear end surface of the core block 291 and the front end surface of the dummy boss 277 to correspond to the differential between the distal end of the outer ring 294 and an outside surface 295 of the core block 291. Therefore, as the core block 291 is pressed backward during extrusion, the rear end surface of the core block 291 comes into contact with the front end surface of the dummy boss 277. The outer ring 294 is stretched and comes into contact with the inner surface of the container to prevent the billet 213 to flow toward the extruding stem 214 of the fixed dummy block 270.

The core block 291, the outer ring 294, and the dummy boss 277 constitute the fixed dummy block 270. Therefore, the outer surface of a front portion of the outer ring 294 is designed to substantially come into contact with the inner surface of the container 201. The core block 291 has a tapered portion 296, the front portion of which is wider than the rear portion, to be in tight contact with a tapered portion disposed on the front inner surface of the outer ring 294. The outer axial portion of the core block 291 and the protrusion 292 is provided with a path 282a which cooling water supplied from the feed water pipe 278 passes through. The distal end of the path 282a extends to a portion near the outside surface 295 of the core block 291.

As shown in FIG. 8, the path 282a is provided with a plurality of cooling paths 298 (eight cooling paths in this embodiment) extending radially from the end of the path 282a to the outer ring 294.

Paths 299 extend in the axial direction from the outer ends of the paths 298 to be disposed near the outer portion of the extruding stem 214 over the dummy boss 277 and the core block 291 and is connected to the hole 289 of the cooling pipe 280. Reference numerals 300, 301, 302, 303 designate plugs and 305, 306, 307 designate heat resistant O-rings, respectively.

The above mechanism for cooling the fixed dummy block may be deleted.

Hereinafter, the operation of the extruder mentioned above will be described.

First, the piston 237 is moved in the left direction of FIG. 1 by supplying pressure oil to a rod side of the container cylinder 235 to advance the container 201, which is now spaced apart from the die 203, so that the container 201 comes into contact with the die 203.

After that, the billet loader 311, on which the billet 213 is now placed, rises up. The billet 213 is pressed into the container 201 according to the advance of the extruding stem 214 and moves toward the die 203.

At this point, the decoration space 231 among the container 201, the die 203, and the billet 213 includes air. When the billet 213 is pressed into the container 201 according to the advance of the extruding stem 214 and a large-diameter end portion 249 of the fixed dummy block 270 passes through the seal block 240, the seal block 240 is closed. The seal block 240 in the closed state is shown by two-dot chain lines in FIG. 18.

When the billet 213 is pressed to a position 10-20 mm before the die 203 as shown in FIG. 1, the electromagnetic switch valve 246 is actuated to allow communication of air between the container 201 and the vacuum tank 220 so that residual air in the container 201 is vacuumed.

The inside of the vacuum tank 220 is already in a vacuumed state of less than 5 torr by the vacuum pump 221.

Once the electromagnetic switch valve 246 is actuated, the residual air in the container 201 is vacuumed by the vacuum tank 220. After 0.2-0.5 seconds, the inside of the container 201 becomes 5-30 torr. Air at the extruding stem 214 side passes through the deaerating holes 245 formed in the seal block 240 and is vacuumed into the vacuum tank 220 through the pipe line 208a, the electromagnetic switch valve 246 disposed above the pipe line 208a, and the pipe line 208b. Therefore, air is quickly and sufficiently exhausted from the deaerating holes 245 of the seal block 240. After that, the extruding stem 214 further moves forward so that the distal end of the billet 213 comes into contact with the die 203, thereby making the hydraulic pressure in a side cylinder higher. When the hydraulic pressure becomes to a predetermined value, a main cylinder (not shown) replaces the side cylinder to supply hydraulic pressure. Thus, the upsetting is completed.

Before starting the upsetting, a coolant supplying device not shown is actuated to introduce the coolant such as cooling water to the cooling paths 298 so as to cool the fixed dummy block 270 form the inside thereof. It should be noted that the cooling water is hard to vapor in the cooling paths 298 and the cooling paths 299 are simply structured. The cooling water is exerted from the rear side of the extruding stem 214 to pass through the feed water pipe 278 in the connection rod 276 of the extruding stem 214, the path 282a, the cooling paths 298, the path 299, and the hole 289 and is then drained from the rear side of the extruding stem 214 through the drain pipe 279.

According to the present invention, the cooling paths 298 are radially disposed near the outside surface 295 from the central portion of the core block 291, thereby lowering the temperature of the outside surface 295 of the fixed dummy block 270 during the upsetting to 200°-230° C. by the cooling water.

Therefore, this prevents the thermal expansion of the large-diameter end portion 249 of the fix dummy block 270 during the extrusion. Since a space between the inner surface of the container 201 and the outer surface of the large-diameter end portion 249 of the fixed dummy block 270 are kept whenever the deaeration is performed from the extruding stem 214 side, the decoration space 231 of the container 201 is sufficiently secured.

When starting the upsetting, a rear end portion of the billet 213 being in contact with the fixed dummy block 270 are cooled.

As the upsetting is started, a peripheral end portion of the billet 213 at the extruding stem 214 side is expanded to come in tight contact with the inner surface of the container 201.

When the upsetting is performed, the rear end portion of the billet 213 is cooled so that the fluidity thereof is decreased and the frictional resistance between the front end surface of the fixed dummy block 270 and the rear end portion of the billet 213 is therefore increased, thereby preventing the surface of the rear end portion of the billet 213 from flowing inside thereof. Therefore, air of small volume existing on the surface of the rear end portion is prevented from being trapped into the rear end portion of the billet 213. The air sealing at the fixed dummy block 270 side is accomplished only by the expansion of the rear end portion of the billet 213.

As described above, the air causing blisters can be sufficiently eliminated by preventing the trapping of the surface of the rear end portion of the billet 213 and the air existing there by cooling the fixed dummy block 270, and by deaerating the space between the surface of the billet 213 and the inner surface of the container 201.

Particularly, in this embodiment, as the temperature of the front end surface of the fixed dummy block 270 is lowered to 250° C. or less, air is prevented from being trapped into the rear end portion of the billet 213 due to the decreased fluidity of the rear end portion of the billet 213, thereby preventing occurrence of blister in an end product. The technical knowledge as described above was obtained by various examinations.

After that, the extruding stem 214 continuously moves forward to squeeze the billet 213.

Soon after that, the extrusion is started to extrude an end product from the die 203.

Upon completion of the upsetting for the billet, after a suitable period from starting the extrusion by the advance of the extruding stem 214 (for example, at a point where ½ length of the initial length of the billet 213 is extruded), the deaeration is stopped and the seal block 240 is opened, that is, the seal block pieces 240B, 240L return to the backward positions thereof. After that, the extrusion by the extruding stem 214 is still performed. Upon completion of the extrusion, the extruding stem 214 is retracted to start a next extrusion cycle.

As apparent also from the above description according to the first embodiment,

(1) the two-piece seal block disposed on the end surface, at the extruding stem side, of the cylindrical container is closed in a direction perpendicular to the axial direction of the extruding stem, thereby making the sealing performance higher and providing sufficient deaeration, without making the whole length of the extruder longer;

(2) the sealing is performed by the two-piece seal block in a short time, thereby reducing the idle time;

(3) the two-piece seal block is spaced apart from the ring-like protrusion and the extruding stem just before the two-piece seal block is closed, thereby making the lives of the sealing members longer;

(4) in case of scrapping off aluminum residues by the outer surface of the fixed dummy block when the extruding stem is returned to the original position after extruding the billet, the scrapped aluminum residues just fall down out of the container, not enter into a groove of the guide plate as the prior arts, thereby keeping the higher sealing performance;

(5) this structure does not necessitate the warp cycle as the prior art, thereby reducing the idle time; and

(6) metal flow in the billet during the extrusion is prevented, thereby stably extruding the material without blister and further significantly improving the yield of the end products.

Hereinafter, a second embodiment of the extruder according to the present invention will be described with reference to the attached drawings.

FIG. 10 is a system diagram of an extruder provided with a preferred deaerator according to the present invention, FIG. 11 is a front view taken along a line 11—11 of FIG. 10, FIG. 12 is a front view taken along a line 12—12 of FIG. 11, FIG. 13 is a plan view taken along a line 13—13 of FIG. 11, FIG. 14 is a front view taken along a line 14—14 of FIG. 13, FIG. 15 is an enlarged partial sectional plan view of a seal block, FIG. 16 is a sectional view taken along a line 16—16 of FIG. 15, FIG. 17 is an enlarged partial sectional plan view of a cooler mounted on the seal block, FIG. 18 is a front view of a billet loader, FIG. 19 is a partially sectional view of a protrusion, FIGS. 20A, 20B, 20C and 20D are enlarged sectional views illustrating various configurations of the inside of the protrusion, FIGS. 21A through 21E are views for explaining the mounting structure of a heat insulating seal block, and FIGS. 22A, 22B and FIGS. 23A, 23B are views illustrating the opening and closing of the seal block and the conditions of spraying coolant.

Views illustrating comparison between a case of a two-piece seal block, both surfaces of which are glued with sealing materials, respectively, and a case without a sealing material are the same as FIGS. 5A and 5B. The conditions of scrapping off aluminum residues glued on the inner surface of a container are the same as shown in FIGS. 6A and 6B. The section of an extruding stem is the same as shown in FIG. 8. The perspective view of a bayonet block is the same as FIG. 9.

As shown in FIG. 10, an end platen 432 is provided with container cylinders 433 for allowing the sliding of a container 401 comprising a container liner 401a, a container tier 402 and a container holder 401c. Reference numeral 436 designates a cylinder tube which is a part of a cylinder body, 437 designates a piston, and 438 designates a piston rod.

Reference numeral 403 designates a die, outer surface of which is slidably supported to the inner surface of a die ring 405. Reference numeral 431 designates a space, as a deaeration space to be deaerated, between the inner surface of the container and the outer surface of the billet 413. An extruding stem 414 for extruding a billet 413 is provided with a fixed dummy block 470 at the tip end thereof which is possible to be in close contact with the inner surface of the container 401.

According to this embodiment, a vacuum aspirator 460 for aspirating residual air from the deaeration space 431 will be now described.

The vacuum aspirator 460 for deaerating the deaeration space 431 from the extruding stem 414 side in the container 401 is arranged on an end surface of the container 401 at the extruding stem 414 side as shown in FIG. 10 and FIG. 11. A pair of brackets 461 is mounted to a tight rod 529 which is, for example, the left one of two upper tight rods 529 as shown in FIG. 11 and FIG. 13 and a movable hydraulic cylinder 462 is pivotally supported on an upper portion between the brackets 461. The movable hydraulic cylinder 462 is provided with a piston rod 462*a*, an end of which is fixed to a clevis 462*b*. The clevis 462*b* is pivotally supported to a triangle bracket 463*b* fixed to a L-like bracket 463*a* extending to the upper end of a pivotable arm 463 so that the two-piece seal block 440 can be moved to a position shown by two-dot chain lines of FIG. 11 by drawing the piston rod 462*a*.

On the other hand, one end of the pivotable arm 463 for the two-piece seal block is pivotally supported to a lower portion of the bracket 461 by a supporting shaft 463*c* and the other end supports the two-piece seal block 440, of which front view is formed in a doughnut-like configuration, allowing the opening and closing of the two-piece seal block 440 through a supporting shaft 464. At the upper side of the two-piece seal block 440, a seal block closing hydraulic cylinder 465 is connected to the two-piece seal block 440 through a link mechanism 466.

The link mechanism 466 opens or closes according to the expansion of the piston rod 465*a* of the seal block closing hydraulic cylinder 465. That is, the two-piece seal block 440 is opened when the piston rod 465*a* is drawn (shown by solid lines in FIG. 14), while the two-piece seal block 440 is closed when the piston rod 465 is stretched (shown by two-dot lines in FIG. 14).

The cylinder 465 is provided with a first limit switch 467, a second limit switch 468, a third limit switch 469 for detecting positions between the backmost positions (the opened state) and the forward-most positions (the closed state) of the seal block pieces 440R, 440L. The first limit switch 468 detects the backmost positions (the opened state) of the seal block pieces 440R, 440L and the second limit switch 468 detects that the seal block pieces 440R, 440L come to a stop at predetermined positions near the extruding stem 414.

The third limit switch 469 turns on when the seal block pieces come to the position where the seal block 440 is closed against the extruding stem 414 so as to actuate an electromagnetic switch valve 490 to connect the deaeration space 431 to the vacuum tank 420, thereby deaerating the inside of the container 401.

As described later, the seal block pieces 440R, 440L are each structured to be separated into an inner seal block piece 440A, positioned at an inner side of the seal block 440 and having sealing members 441 and 444 disposed on the inner surface thereof, and an outer seal block piece 440B, positioned outside the inner seal block piece 440A, for holding the inner seal block pieces 440A. For preventing air infiltration between the contact surfaces 440*a* of the seal block pieces 440R, 440L when the seal block 440 is closed as shown by chain lines in FIG. 11, the contact surfaces 440*a* are provided with sealing members 446 (sheet-like sealants) attached thereon. For example, the sealing members 446 are preferably sponge-like sealants, having heat resistance and resiliency, made of silicon rubber or fluoro-rubber.

When the seal block 440 is closed, the seal block 440 comes into sealing contact with a protrusion 480 (described later) through the sealing members 446 attached to the contact surfaces 440A of the seal block pieces 440R, 440L and sealing members 441 disposed on the inner surfaces of the seal block pieces 440R, 440L and comes into sealing contact with the fixed dummy block 470 and an outer surface of the extruding stem 414 through sealing members 444.

Among the sealing members 441, 444, 446, the sealing members 441 and 444 are preferably made of a heat resistant and high deformable material, such as relatively hard string-like silicone rubber and string-like fluoro-rubber.

On the other hand, the sealing members 446 are preferably made of soft sponge-like rubber by comparison with the sealing members 441, 444, for example, heat resistant sponge-like material such as sponge-like silicone rubber sheet and sponge-like fluoro-rubber sheet.

Particularly, when the seal block 440 is closed relative to the extruding stem 414, the sealing members 444 are pulled in a direction of arrow because of the friction between the outer surface of the extruding stem 414 and the sealing members 444 as shown in FIG. 5B, thereby causing a space S between ends of the contact surfaces 440A.

In case where the sealing members 446 of sponge-like soft rubber (each 3 mm in thickness) are attached to the contact surfaces 448A of the seal block pieces 448R and 448L as shown in FIG. 8A, the sealing members 446 are compressed when the seal block 448 is closed and free ends of the sealing members 446 are about to project toward the extruding stem, thereby preventing the aforementioned space S. This effect is common to the sealing members 441. That is, a space on an outer surface of the protrusion 480 can be prevented by the sealing member 441.

When the seal block pieces 448R, 448L return to the backmost positions thereof as shown by solid lines in FIG. 11, a billet loader 511 (described later) can move out and in with the billet 413 mounted thereon. The seal block pieces 448R, 448L are each provided with a descenting hole 445 which is connected to an end of a flexible pipe line 488a, the other end being connected to a fixed pipe line 488b through an electromagnetic switch valve 490. The fixed pipe line 488b is connected to a vacuum tank 420.

As shown in FIGS. 16 and 19, the container 401 is provided with a concavity 450 which is formed in the container tire 402 at the extruding stem 414 side and is coaxially engaged to the container liner 401a, and into which an insulator 447 formed in a doughnut-like configuration is inserted. An engaging member 451 having a protrusion 480 protruding, in a L shape in its section, toward the extruding stem 414 is mounted on the insulator 447 by bolts 452 spaced with a constant pitch.

Reference numeral 456 is a ring-like projection which acts as a stopper for preventing deformation of the insulator 447 when the engaging member 451 is attached to the end surface, at the extruding stem 414 side, of the container tire 402 by the bolts 452 after laying the engaging member 451 on the insulator 447 since the insulator 447 is made of relatively soft material. The insulator 447 also has a function as sealant for preventing air infiltration from its outside during vacuuming air in the container 401.

The container tire 402 is also provided with a heat insulating plate 448 disposed further outside the engaging member 451 by screws 454 with a pitch circle different from that of the bolts 452. The protrusion 480 is inserted into a heat insulating ring 453. The temperature of the outer surface of the heat insulating ring 453 is kept at 200° C. or less by superposing the insulator 447, the engaging member 451, and the heat insulating plate 448 which constitute a heat insulating seal block 455 and disposing the heat insulating ring 453 around the protrusion 480 of the engaging member 451. The temperature is quite low relative to the average of the temperature of the container 401 of 400° C.

Even when the sealing members 441 frequently come into contact with the heat insulating ring 453 according to the opening and closing of the two-piece seal block 440, this structure prevents the deterioration of the sealing members 441 due to heat history, prevents heat conduction from the container 401 to the vacuum aspirator 460, and prevents the seal block pieces 448R, 448L from rubbing against the surface of the heat insulating plate 448 disposed on the insulator 447 to allow the movement between the backmost position and the forward-most positions. The insulator 447 is preferably made of siliceous material having fine porous structure, the engaging member 451 is preferably made of tool steel or heat resistant steel, and the heat insulating plate 448 is preferably made of high-functional resin.

If the heat insulating seal block 455 is covers overall the end surface, at the extruding stem 414 side, of the container 401 of a general purpose extruder (shown in FIG. 21A) as shown in FIG. 21B, the end surface of the container 401 projects toward the extruding stem 414 so as to cause interference between the No. 2 billet loader 511b and the heat insulating seal block 455. Such interference may be prevented by lengthening the extruding stem 414 or moving the first billet loader 511 toward the extruding stem. However, it necessitates significantly remodeling of the first billet loader 511.

Additionally, it is expensive to cover the heat insulating seal block 455 overall and there is a problem of the strength since a lot of bolt holes must be formed in the end surface of the container 401 for mounting the heat insulating seal block 455 to the container tire 402.

In this embodiment, as shown in FIG. 21C, the container tire 402 is provided with the concavity 450 formed in a doughnut configuration in which the heat insulating seal block 455 is inserted, thereby making the projection of the heat seal block 455 shorter, and a short billet liner 511c of the No. 2 billet loader 511b is provided not to interfere with the protrusion 480 of the engaging member 451 constituting the heat insulating seal block 455. In this embodiment, it is not limited to provide the short billet liner 511c not to interfere with the protrusion 480 as described above. It may dispose the billet loader 511 at a position not to interfere with the protrusion 480, when installing a new extruder.

In addition, for restoring the container 401 in this embodiment to the container of general purpose extruder as shown in FIG. 21A, the heat insulating seal removed and a removed and a restoring block 456 is inserted into the concavity 450 by bolts (not shown) as shown in FIG. 21D and FIG. 21E.

In consideration of a case where the inside of the extruding stem 414 is not cooled, the inner diameter Y of the protrusion 480 disposed on the heat insulating plate 448 is structured to be larger than the inner diameter X of the container liner 401a as shown in FIG. 19 (X<Y).

This facilitates the decoration of the inside of the container 401 since there is a ring-like space between Y-X even when the diameter of the large-diameter end portion 449 becomes the same as the inner diameter X of the container liner 401a by gluing aluminum residues on the surface of the large-diameter end portion 449. In case where the inside of the fixed dummy block 470 is cooled to make the outside surface 496 at 200°-250° C. or less by letting cooling water run in a cooling tube 591 (described later), the surface temperature of the large-diameter end portion 449 of the fixed dummy block 470 is cooled to 200°-250° C. or less so that the diameter of the large-diameter end portion 449 is smaller than the inner diameter X of the container liner 401a before next extrusion even when aluminum residues are glued on the surface of the large-diameter end portion 449 of the fixed dummy block 470 to make the diameter of the large-diameter end portion 449 larger, for example, the diameter of the large-diameter end portion 449 becomes the same as the inner diameter X of the container liner 401a just after the extrusion. Therefore, the decoration space 431 as a descenting path is kept also in this case.

Moreover, the protrusion 480 is provided with a tapered surface, the inner diameter of which is larger at the extruding stem 414 side to facilitate insertion of the large-diameter end portion 449 of the fixed dummy block 470 of the extruding stem into the container 401 with the billet 413 being easily pressed into the container 401. The container liner 401a is also provided with a tapered surface wherein an inner surface is larger at the protrusion 480 side and the tapered surface is smoothly connected to the inner surface of the protrusion 480.

When the large-diameter end portion 449 of the fixed dummy block 470 passes through the inside of the protru-

sion 480, there is a ring-like space between the circular large-diameter end portion 449 and the inner surface of the circular protrusion 480. However, it is not limited to this structure, for example, the space may be an intermittent space formed by projections 480a disposed around the inner surface of the protrusion 480 as shown in FIG. 20C.

As described above, the engaging member 451 is provided with the protrusion 480 disposed on the surface at the extruding stem 414 side, corresponding to the container liner 401a so that the seal block 440 seals through the sealing members 441 when the seal block 440 is closed against the heat insulating ring 453 attached around the protrusion 480.

The insulating plate 448 is provided with the protrusion 480, front surface of which is formed in a ring-like configuration in a position corresponding to a container liner 401a. When the seal block 440 is closed, the protrusion 480 comes in sealing contact with the seal block 440 through the sealing members 441. Reference numeral 421 designates a vacuum pump and 422 designates a motor.

Another one of main features of the present invention is that there is no cover plate nor guide rail for the close motion of the seal block 440. The pivotable arm 463 pivots about the supporting shaft 463c to the backmost position by drawing the piston rod 462a of the movable hydraulic cylinder 462 with the seal block 440 being opened without interference with the No. 1 billet loader 511a.

The above structure facilitates the exchange of the container tire 402 and the container liner 401a and does not deteriorate the sealing performance because in case of scrapping off aluminum residues glued on the inner surface of a container liner 401a by the outer surface of the fixed dummy block 470 when the extruding stem 414 returns to the original position after extruding the billet 413, the scrapped aluminum residues just fall down from the edge of the inner surface of the protrusion 480 as shown in FIG. 6A and FIG. 6B, does not enter into a groove of the guide plate as the prior art which causes hitches to the close motion of the seal block 440.

In this embodiment, the extruder is provided with a cooler 491 for spraying coolant to the sealant such as the sealing members 441, 444.

The seal block pieces 440R, 440L are each structured to be separated into an inner seal block piece 440A, positioned at an inner side of the seal block 440 and having sealing members 441 and 444 disposed on the inner surface thereof, and an outer seal block piece 440B, positioned outside the inner seal block piece 440A, for holding the inner seal block piece 440A. The outer seal block piece 440 is attached to the inner seal block piece 44A by tap bolts 495 with a suitable pitch.

As shown in FIG. 16, the inner seal block piece 440A is provided with a half-circle groove formed inside thereof and provided with a covering 498 to form a first coolant path 496. The first coolant path 496 is provided with a plurality, in slits radially extending inwardly of which openings toward the sealing members 444 are first gas outlets 500 of the first coolant path 496 to suitably cool the sealing members 444.

There is also a second coolant path 497 between the inner seal block piece 440A and the outer seal block piece 440B. The second coolant path 497 is connected to the first coolant path 496 to correspond to the first coolant path 496 and is provided with a plurality of second gas outlet 501 toward the sealing members 441 to spout out coolant from the second gas outlets 501 to cool the sealing members 441.

Though the first coolant path 496 and the second coolant path 497 are connected each other in this embodiment, the first coolant path 496 and the second coolant path 497 may be separately disposed.

The outer seal block piece 440B is connected to one end of a flexible pipe line 492. The other end of the flexible pipe line 492 is connected to a fixed pipe line 494 through an electromagnetic switch valve 493. The fixed pipe line 494 is connected to a coolant supply source (not shown). Cooling gas as the coolant is spouted out from the first gas outlets 500 and the second gas outlets 501 regardless whether the seal block 440 is opened or closed.

The description will now be made as regard to the billet loader 511 with reference to FIG. 11 and FIG. 18.

As shown in FIG. 11, there are a first billet loader 511 and a second billet loader 540. The second billet loader 540 comprises a telescopic cylinder 545, a movable frame 546, linear guides 547, a holder 554, a pair of billet loader swing arms 549, a pair of pivotable stoppers 550, a pair of frame back stoppers 551, a pair of stopper back stoppers 552, and a fixed frame 553.

The second billet loader 540 receives the billet 413 conveyed by a billet carrier 541 when the second billet loader 540 is in a forward-most position as shown by chain lines in FIG. 11 and pivots to the same position of the backmost position of the first billet loader 511 to hand over the billet to the first billet loader 511 disposed on the side of the container 401.

That is, the billet carrier 541 has a slide (not shown) disposed near the base of the extruder and a delivery holder 543 to deliver the billet 413 to the second billet loader 540 through the slide.

The delivery holder 543 has a V-like billet receiving portion and is pivotally supported by a supporting shaft 544 to allow the pivotal movement of the receiving portion. The delivery holder 543 is actuated by a cylinder mechanism (not shown) so that, first, it receives the billet 413 with the opening of the V-like billet receiving portion facing the upstream of the slide and pivots downward to send out the billet 413 to the second billet loader 540.

The second billet loader 540 is positioned to face the billet carrier 541 so that the billet carrier 541 delivers the billet 413 one by one to the second billet loader 540.

The telescopic cylinder 545 having a stretchable rod 545 is disposed on an end of the fixed frame 553 in the axial direction. The movable frame 546 is connected to the end of the rod 545a through a connecting member 557.

The linear guides 547 are disposed on the both sides of the fixed frame in the longitudinal direction. The movable frame 546 is movable along the linear guides.

The bar-like frame back stoppers 551 are disposed on one side 555 of the fixed frame 553 at the upper side to regulate the backward limits of the movable frame by rotating adjustable screws 556.

On the other hand, the bar-like stopper back stoppers 552 are disposed on the side 555 of the fixed frame 553 at the lower side to regulate the backward limits of the pivotable stoppers 550 by rotating adjustable screws 558. The rear ends of the billet loader swing arms 549 come into contact with the pivotable stoppers 550. The billet loader swing arms 549 pivot about a pivot shaft 548 to deliver the billet 413, which is placed on the billet holder 554 disposed on the end of the billet loader swing arms 549, to an intermediate stopping position.

Hereinafter, the fist billet loader 511 will be now described.

The first billet loader 511 receives the billet 413 from the second billet loader 540 at the intermediate stopping position and delivers the billet 413 to a billet loading opening

526. The billet loader 511 is mounted to a fixed frame 561 projecting from the container 401 toward the extruding stem 14 and comprises a No. 1 billet loader 511a and the No. 2 billet loader 511b, which are integrally movable with the container, as shown in FIG. 18.

The first billet loader 511 comprises the No. 2 billet loader 511b which is pivotally positioned adjacent to the container 401 and the No. 1 billet loader 511a which is pivotally positioned adjacent to the No. 2 billet loader 511b.

The first billet loader 511 disposed corresponding to the second billet loader 540 and is provided with a first swing arm 562 of the No. 1 billet loader 511a and a second swing arm (not shown) of the No. 2 billet loader 511b.

The description will be made as regard only to the first swing arm 562. One end of the first swing arm 562 is pivotally fixed by a supporting shaft 563 disposed below one of below tight rods 529. The fixed frame 561 is provided with an upper stopper 564 at the upper end thereof and a lower stopper 565 at the lower end thereof. The lower stopper 565 regulates the lowermost position of the first billet loader 511 to facilitate receiving from the second billet loader 540 with the first billet loader 511 and the second billet loader 540 being in the same level.

On the other hand, the upper stopper 564 regulates the uppermost position of the first billet loader 511 to facilitate loading of the billet 413 to the billet loading opening 526 when the first billet loader 511 delivers the billet 413, received from the second billet loader 540, from the intermediate stopping position to the billet loading opening 526.

The first swing arm 562 of the No. 1 billet loader 511a is connected to a piston rod 566a of a first hydraulic cylinder 566 so that the first swing arm 562 is moved between the lowermost position shown by chain lines and the uppermost position shown by solid lines in FIG. 11 by the stretch motion of the piston rod 566a. Reference numeral 567 designates a second hydraulic cylinder which is connected to the second swing arm of the No. 2 billet loader 511b through a piston rod 567a.

The first swing arm 562 is provided with a first billet holder 568 at the end thereof for holding the billet 413. The first billet holder 568 has three seat plates 569 for supporting the bottom of the billet 413, thereby securely holding the billet 413.

The first billet holder 568 is provided with a crimping arm 571 fixed to one end thereof by a supporting shaft 570.

A connecting member 572 fixed to the crimping arm 571 at a constant angle with the lower edge of the cramp arm 571 is connected to an end of a rod of a compensating cylinder for crumping or releasing the billet 413 so that the crumping arm 571 can pivot according to the stretch motion of the rod. Therefore, the billet 413 is supported at least at three points by plates 569 and the crumping arm 571 in the first billet holder 568, thereby preventing the billet from coming off when delivered.

As for the structure of the extruding stem 414, there are two cases: where the fixed dummy block 470 and the extruding stem 414 is connected through a bayonet block 580 and where the fixed dummy block 470 is directly connected to the extruding stem 414 by screwing.

In this embodiment, the case where the fixed dummy block 470 and the extruding stem 414 are connected through the bayonet block as shown in FIG. 8 will be described as a typical structure.

The fixed dummy block 470 is fixed to the front surface of the extruding stem 414 and is slidably disposed in the container liner 401a.

The rear end of the extruding stem 414 is fixed to a cross head 475 through a stem holder 473 and a pressure ring 474 as shown in FIG. 16.

The bayonet block 580 is disposed on the front surface of the extruding stem 414. A distal end of a connection rod 581 having a circular section is screwed into the rear half of the bayonet block 472 so that the connection rod 581 is attached to the bayonet block 580. The connection rod 581 has a large-diameter portion 582 at the rear end thereof. The large-diameter portion 476a is fixed to a hole formed in the rear end portion of the extruding stem 414 so that tapered surfaces therebetween are engaged each other.

The front half of the bayonet block 580 has a structure of a bayonet type as shown in FIG. 8 and is provided with, for example, three protrusions 586 disposed at equal spaces.

On the other hand, a dummy boss 587 is provided with concavities 588 disposed at equal spaces to engage the protrusions 586. Installing the dummy boss 587 to the bayonet block 580 is securely and quickly accomplished by engaging the protrusion 586 of the bayonet block 580 with the concavities 588 of the dummy boss 587 and rotating the dummy boss 587 about 60 degree.

The connection rod 581 is provided with a through hole extending in the axial direction, in which a feed water pipe 589 and a drain pipe 590 are disposed. The feed water pipe 589 and the drain pipe 590 constitute a cooling pipe 591. One ends of the feed water pipe 589 and the drain pipe 590 are secured to holes 593, 594 of a cooling pipe end block 592 by welding and the other ends extend to the inside of the pressure ring 584. The end of the feed water pipe 589 is connected to a cooling water pump (not shown) through a path 595 of a pipe in the pressure ring 584, a valve 596, and a pipe line 597. The end of the drain pipe 590 is connected to a drain port 599 through a path 598 of a pipe in the pressure ring 584.

There is a slight space between the inner surface of the extruding stem 414 and the outer surface of the connection rod 581 to keep the flexibility of the axis of the connection rod 581. There is also slight spaces between the inner surface of the connection rod 581 and the outer surfaces of the feed water pipe 589 and drain pipe 590 not to directly cool the connection rod 581. Additionally, there is also a slight space between the inner surface of the connection rod 581 and the cooling pipe end block 592 to keep the flexibility of the axis of the connection rod 581.

In this case, since the feed water pipe 589 and the drain pipe 590 are inserted into the through hole formed in the connection rod 581, the connection rod 581 is not directly contruding the temperature difference between the extruding stem 414 and the connection rod 581 is therefore a little so as not to impair the flexibility of the axis of the fixed dummy block 470.

The hole 593 extends over the cooling pipe end block 592. The front end of the hole 593 is connected to a hole 600 allowing the outward flow through a cooling pipe end block 592. The dummy boss 587 is provided with a central through hole 601 into which a small cylindrical protrusion 603 formed in a middle portion of a core block 602 is inserted. The core block 602 comes in tight contact with the dummy boss 587 by engaging a connection nut 604 to a screw thread formed in the protrusion 603 from the rear side of the dummy boss 587 and screwing up the connection nut 644.

The dummy boss 587 is provided with a cylindrical outer ring 605 integrally fixed to the front end periphery thereof. There is a space between the rear end surface of the core block 602 and the front end surface of the dummy boss 587 to correspond to the differential between the distal end of the outer ring 605 and an outside surface 606 of the core block 602. Therefore, as the core block 602 is pressed backward during extrusion, the rear end surface of the core block 602

comes into contact with the front end surface of the dummy boss 587. The outer ring 605 is stretched and comes into contact with the inner surface of the container to prevent the billet 413 to flow toward the extruding stem 414 of the fixed dummy block 470.

The core block 602, the outer ring 605, and the dummy boss 587 constitute the fixed dummy block 470. Therefore, the outer surface of a front portion of the outer ring 605 is designed to substantially come into contact with the inner surface of the container 401. The core block 602 has a tapered portion 607, wherein the front portion is wider than the rear portion, to be in tight contact with a tapered portion disposed on the front inner surface of the outer ring 605. The center axial portion of the core block 602 and the protrusion 603 is provided with a path 608 which cooling water supplied from the feed water pipe 589 passes through. The distal end of the path 608 extends to a portion near the outside surface 606 of the core block 602.

The path 608 is provided with a plurality of cooling paths 609 (eight cooling paths in this embodiment) extending radially from the end of the path 608 to the outer ring 605. Paths 610 extend in the axial direction near the outer portion of the extruding stem 414 from the outer ends of the paths 609 over the dummy boss 587 and the core block 602 and are connected to the hole 600 of the cooling pipe 591. Reference numerals 611, 612, 613 designate pings and 615, 616, 617 designate heat resistant O-rings, respectively.

Hereinafter, the operation of the extruder mentioned above will be described.

First, before starting the upsetting, a coolant supplying device not shown is actuated to introduce the coolant such as cooling water to the cooling paths 609 so as to cool the fixed dummy block 470 form the inside thereof. The cooling water is entered from the rear side of the extruding stem 414 to pass through the feed water pipe 589 in the connection rod 581 of the extruding stem 414, the path 608, the cooling paths 609, the path 610, and the hole 600 and is then drained from the rear side of the extruding stem 414 through the drain pipe 590. According to the present invention, the cooling paths 609 are radially disposed near the outside surface 606 from the central portion of the core block 602, thereby lowering the temperature of the outside surface 606 of the fixed dummy block 470 during the upsetting to 200°–230° C. by the cooling water.

Therefore, this prevents the thermal expansion of the large-diameter end portion 449 of the fix dummy block 470 during the extrusion. Since a space between the inner surface of the container 401 and the outer surface of the large-diameter end portion 449 of the fixed dummy block 470 is kept whenever the deaeration is performed from the extruding stem 414 side, the deaeration space 431 of the container 401 is sufficiently deaerated.

Once the fixed dummy block 470 is cooled to a predetermined temperature, as shown in FIGS. 22A, 22B, 23A, 23B, the seal block pieces 440R, 440L are moved from backmost positions (shown by solid lines in FIG. 11) to the forward-most positions (shown by two-dot chain lines in FIG. 11) according to the stretch motion of the piston rod 465a of the seal block closing hydraulic cylinder 465. As shown in FIG. 22A, the sealing members 441 and 444 are cooled by cooling gas spouted out from both of the first gas outlets 500 formed in the inner seal block 440A and the second gas outlets 501, thereby preventing the deterioration of the sealing performance of the sealing members 441 and 444 even when the sealing members 441 and 444 come in contact with the outer surface of the fixed dummy block 470 and the outer surface of the heat insulating ring 453, respectively, with the seal block 440 being closed.

As the cylinder 465 is supplied with pressure oil at this point, the cylinder 465 advances the seal block pieces 440R, 440L with spraying cooling gas to the sealing members 444 and 441 from the first gas outlets 500 and the second gas outlets 501.

When the seal block pieces 440R, 440L get closer to the extruding stem 414 and the fixed dummy block 470, the cooling gas spouted out from the first gas outlets 500 and the second gas outlets 501 blows off dusts and residues glued on the outer surfaces of the heat insulating plate 448 and the heat insulating ring 453 (as shown in FIG. 22B).

When the seal block pieces 440R, 440L are further close to the extruding stem 414 and the fixed dummy block 470, the outer surfaces of the extruding stem 414 and the fixed dummy block 470 are cooled by the cooling gas spouted out from the first gas outlets 500 and the second gas outlets 501 and further dusts and residues glued on the outer surfaces of the heat insulating plate 448 and the heat insulating ring 453 are blown off by the pressure of the cooling gas (as shown in FIG. 23A).

Also after the seal block pieces 440R, 440L come into contact with the fixed dummy block 470 and the heat insulating ring 453, the cooling gas is continuously spouted out from the first gas outlets 500 and the second gas outlets 501. The cooling gas is blocked from entering into the deaeration space 431 by the sealing members 441 and 444 so that the cooling gas flows outward as shown in FIG. 23B.

The billet 413 is squeezed as follows. First, the piston 437 is moved in the left direction by supplying pressure oil to a rod side of the container cylinder 433 to advance the container 401, which was spaced apart from the die 403, so that the container 401 comes into contact with the die 403. After that, the first swing arm 562 is raised up by drawing the piston rods 566a and 567a of the first hydraulic cylinder 566 and the second hydraulic cylinder 567 of the first billet loader 511 so that the billet 413 is positioned to be loaded to the billet loading opening 526 with the billet 413 being held by the first billet holder 568 and the second billet holder (not shown).

As described above, in an initial stage, the seal block pieces 440R, 440L are positioned at the backmost positions as shown by solid lines in FIG. 11. The limit switch 647 is still ON. The billet loader 511 rises from this state with holding the billet 413 thereon. Then, the extruding stem 414 starts to move forward at a constant speed. At the same time, the piston rod 465a is projected so that the two-piece seal block 440 starts to close. The second limit switch 468 turns on at a predetermined position where the seal block pieces 440R, 440L get radially closer to the extruding stem 414 so that the seal block pieces 440R, 440L come to a stop. On the other hand, the billet 413 is pressed into the container 401 according to the advance of the extruding stem 414 and moves toward the die 403. On the way, the No. 1 billet loader 511a and the No. 2 billet loader 511b are lowered to a position where the No. 1 billet loader 511a and the No. 2 billet loader 511b do not interfere with the seal block pieces 440R, 440L. At this point, the extruding stem 414 continuously moves forward. Once the extruding stem 414 comes to a predetermined position, the extruding stem 414 is decelerated by a rotary encoder (not shown).

As the extruding stem 414 is decelerated, electromagnetic valve (not shown) disposed above an introduction tube of the seal block closing hydraulic cylinder 465 is actuated to advance again the seal block pieces 440R, 440L to the forward-most position where the seal block pieces 440R, 440L stop. At this point, the extruding stem 414 presses the billet 413 into the container to the predetermined position.

As described before, since the outer surface of the fixed dummy block 470 is already cooled to approximately 200°–250° C. at this point, a rear end portion of the billet 413 being in contact with the fixed dummy block 470 is cooled when starting the upsetting. After starting the upset, the rear end portion, at the extruding stem 414 side, of the billet 413 swells so as to come into close contact with the container 401.

When the upsetting is performed, the rear end portion of the billet 413 is cooled so that the fluidity thereof is decreased and the frictional resistance between the front end surface of the fixed dummy block 470 and the rear end portion of the billet 413 is therefore increased, thereby preventing the surface of the rear end portion of the billet 413 from flowing inside thereof. Therefore, air of small volume existing on the surface of the rear end portion is prevented from being trapped into the rear end portion of the billet 413. Thus, the air causing blisters can be sufficiently eliminated by preventing the trapping the surface of the rear end portion of the billet 413 and air existing there by cooling the fixed dummy block 470, and by deaerating the space between the surface of the billet 413 and the inner surface of the container 401.

After that, as the two-piece seal block 440 is closed against the fixed dummy block 4470 and the heat insulating ring 451, the third limit switch 469 turns on to drive the vacuum aspirator 460 and actuate the electromagnetic switch valve 496 so as to allow the communication between the vacuum aspirator 460 and the deaeration space 431, which is formed among the container 401, the die 403 and the billet 413.

Air in the deaeration space 431 passes through the deaerating holes 445 formed in the seal block 440 and is vacuumed into the vacuum tank 420 through the pipe line 408a, the electromagnetic switch-valve 496 disposed above the pipe line 408a, and the pipe line 408b. Therefore, air is quickly and sufficiently exhausted from the deaerating holes 445 of the seal block 440.

The inside of the vacuum tank 420 is already in a vacuumed state of less than 5 torr by the vacuum pump 421. When the billet 413 is pressed into the container 401 according to the advance of the extruding stem 414 and a large-diameter end portion 449 of the fixed dummy block 470 passes through the seal block 440, the seal block 440 is closed.

Once the electromagnetic switch valve 446 is actuated, the residual air in the container 401 is vacuumed by the vacuum tank 420. After 0.2–0.5 seconds, the inside of the container 401 becomes 5–30 torr. The extruding stem 414 further moves forward so that the distal end of the billet 413 comes into contact with the die 403, thereby making the hydraulic pressure in a side cylinder higher. When the hydraulic pressure becomes to a predetermined value, a main cylinder (not shown) replaces the side cylinder to supply hydraulic pressure. Thus, the upsetting is completed.

After that, the extruding stem 414 continuously moves forward to squeeze the billet 413. Soon after that, the extrusion is started to extrude an end product from the die 403. Upon completion of the upsetting for the billet, after a suitable period from starting the extrusion by the advance of the extruding stem 414 (for example, at a point where ⅓ length of the initial length of the billet 413 is extruded), the deaeration is stopped and the seal block 440 is opened, that is, the seal block pieces 440R, 440L return to the backmost positions thereof. After that, the extrusion by the extruding stem 414 is still performed to complete the extrusion.

While the billet 413 is squeezed from the die 403 to make the end product, the first billet holder 568 of the first billet loader 511 is lowered to the lower-most position, while the rod 545a of the telescopic cylinder 545 is expanded to horizontally move the billet holder 554 of the second billet loader 540 to the forward-most position to face the billet carrier 541. Then, the delivery holder 543 of the billet carrier 541 pivots so that the next billet 413 is entered into the billet holder 554. In this condition, the rod 545a of the telescopic cylinder 545 is drawn fully. The first billet holder 568 is moved from the lower-most position to the intermediate stopping position.

When the container 401 comes into contact with the die 403, the holder 554 disposed at the end of the swing arm 549 of the second billet loader 540 pivots to the position corresponding to the lower-most position of the first billet loader 511. The second billet loader 540 then hands over the billet 413 to the first billet loader 511.

As apparent also from the above description, according to the second embodiment,

(1) since the two-piece seal block disposed on the end surface of the container at the extruding stem side is moved from a position near the tight rod to the extruding center position and after that the two-piece seal block is closed by another cylinder, the two-piece seal block can be sufficiently moved to a position where the seal block does not interfere during the exchange of container liner, thereby proving easy operation. Additionally, the seal is sufficient so that the degree of vacuum is higher and the deaeration is sufficiently performed, thereby preventing occurrence of blister and significantly improving the yield of the end products;

(2) the inner surface of the ring-like protrusion at the extruding stem side is provided with an annular deaerating groove so that the inside of the container can be deaerated even when aluminum residues are glued on the surface of the large-diameter end portion of the fixed dummy block to make the diameter of the large-diameter end portion larger, thereby stably extruding the material without blister and further significantly improving the yield of the end products;

(3) the sealing is performed by the two-piece seal block in a short time, thereby reducing the idle time;

(4) the two-piece seal block is spaced apart from the ring-like protrusion and the extruding stem just before the two-piece seal block is closed, thereby making the lives of the sealing members longer;

(5) in case of scrapping off aluminum residues by the outer surface of the fixed dummy block when the extruding stem is returned to the original position after extruding the billet, the scrapped aluminum residues just fall down out of the container, not enter into a groove of the guide plate as the prior art, thereby keeping the higher sealing performance;

(6) this structure does not necessitate the verp cycle as the prior art, thereby reducing the idle time; and

(7) the end surface of the container at the extruding stem side is provided with a doughnut-like groove formed therein and the smallest heat insulating seal block made of heat insulating material is inserted into the doughnut-like groove, thereby preventing heat transfer from the container, and the heat insulating seal block is attached to a part of the end surface of the container so that fewer bolt holes formed in the end surface of the container is enough, thereby preventing deterioration of the mechanical strength; and

(8) the outer surface of the fixed dummy block is cooled to the predetermined temperature so that the rear end

portion of the billet is also cooled, thereby preventing the metal flow of the billet and thus preventing occurrence of blister.

What is claimed is:

1. An extruder for a billet comprising:

a cylindrical container adapted to receive the billet therein and having an end surface;

an extruding stem to be entered into the cylindrical container through the end surface of the cylindrical container;

guide rods situated near the end surface of the cylindrical container and extending perpendicular to an axial direction of the container;

a two-piece seal block disposed on the end surface of said container and formed of two block pieces, each block piece having at one side a contact surface with a seal member made of a heat resistant and resilient material and at a side away from the contact surface through rings, said guide rods passing through the through rings of the block pieces to guide the block pieces for opening and closing the block pieces so that when the block pieces are closed perpendicular to the axial direction of the container along the guide rods, the seal members of the block pieces contact the extruding stem and the container;

vacuum deaerating holes formed in the block pieces of the seal block for removing air therethrough; and

a fixed dummy block attached to an end of the extruding stem and having an internal cooling function at a front portion thereof for cooling the dummy block and a rear portion of the billet.

2. An extruder as claimed in claim 1, further comprising an insulating plate attached to the cylindrical container and having a protrusion at a radially inner side thereof, said protrusion extending in the axial direction of the container and having an outer surface, said seal member having a first sealing member contacting said outer surface of the protrusion and a second sealing member contacting an outer surface of the extruding stem.

3. An extruder as claimed in claim 1, wherein said vacuum deaerating hole is connected to a vacuum tank.

4. An extruder as claimed in claim 1, wherein said fixed dummy block and said extruding stem are provided with cooling paths extending to a forward end of the dummy block, through which cooling water passes to cool the fixed dummy block.

5. An extruder as claimed in claim 1, wherein the front end surface of said fixed dummy block is cooled to 250° C. or less.

6. An extruder for a billet comprising:

a container having a container liner adapted to receive the billet therein and having an end surface;

a ring-shape protrusion disposed on the end surface of the container,

an extruding stem to be entered into the container liner through the end surface of the container;

guide rods situated near the end surface of the container and extending perpendicular to an axial direction of the extruding stem; and

a two-piece seal block disposed on the end surface of said container and formed of two block pieces, each block piece having at an inner side a step shape portion, at a side away from the inner side through rings and a seal member attached to the step shape portion, said guide rods passing through the through rings of the block pieces to guide the block pieces for opening and closing the block pieces so that when the block pieces are closed perpendicular to the axial direction of the extruding stem along the guide rods, the seal members attached to the step shape portions of the block pieces contact outer surfaces of the extruding stem and the ring-shape protrusion to seal a deaeration space in the container liner.

7. An extruder as claimed in claim 6, wherein said seal block is provided with a vacuum deaerating hole for eliminating residual air in the container wherein said vacuum deaerating hole is connected to a vacuum pump.

8. An extruder as claimed in claim 6, said seal member has heat resistance and resiliency and attached to contact surfaces of seal block which come into contact with each other when said seal block is closed.

9. An extruder as claimed in claim 6, wherein when said seal block is opened, said seal block can be moved not to interfere with a billet loader on which the billet to be loaded is placed and not to interfere with exchange of said container liner.

10. An extruder for a billet comprising:

a container having a container liner adapted to receive the billet therein and having an end surface;

a ring-shape protrusion disposed on the end surface of the container,

an extruding stem to be entered into the container liner through the end surface of the container;

a ring-shape seal block formed of a pair of seal block pieces disposed near the container at a side of the extruding stem, said seal block pieces being opened and closed by swinging motion in a direction perpendicular to an axial direction of the extruding stem and having step shape portions with sealing members to abut against outer surfaces of the ring-shape protrusion and the extruding stem at the same time when the seal block pieces are closed, said seal block pieces contacting the outer surfaces of the ring-shape protrusion and the extruding stem at the same time through the sealing members to seal a deaerating space in the container liner; and

a hydraulic cylinder attached to the seal block for opening and closing the seal block pieces, said hydraulic cylinder having a rod such that when said rod is moved linearly, the seal block pieces rotate and move between a closed position and a retracted rear position.

11. An extruder as claimed in claim 10, wherein said seal block is provided with a vacuum deaerating hole for eliminating residual air in the container wherein said vacuum deaerating hole is connected to a vacuum pump through a pipe line.

12. An extruder as claimed in claim 10, wherein a fixed dummy block provided with an internal cooler for cooling said fixed dummy block is attached to the extruding stem.

13. An extruder as claimed in claim 10, wherein said seal block is provided with a cooler for cooling said sealing member.

14. An extruder as claimed in claim 10, wherein said ring-like protrusion is provided with a deaerating groove formed in an inner surface thereof at the extruding stem side, said deaerating groove being formed in a circular shape, an inner diameter of which is larger than the outer diameter of said fixed dummy block fixed to an end of said extruding stem.

15. An extruder as claimed in claim 10, wherein said seal block pieces are each structured to be separated into an inner

seal block piece, positioned at an inner side of the seal block and having said sealing member, and an outer seal block piece, positioned outside the inner seal block piece to hold the inner seal block piece, wherein said inner seal block piece has a first coolant path formed radially and covered by a lid, a second coolant path between said inner seal block piece and said outer seal block piece, and gas outlets for spraying coolant to said sealing members and for blowing off materials attached thereto.

16. An extruder as claimed in claim 10, wherein said seal block pieces are disposed above said extruding stem.

17. An extruder as claimed in claim 10, wherein said seal block is provided with seal block pieces pivotally mounted for closing and opening said seal block, said seal block pieces pivot so as to clamp the outer surface of said ring-like protrusion and the outer surface of the fixed dummy block or the extruding stem through the sealing members when said seal block is closed.

18. An extruder as claimed in claim 10, further comprising a guide ring disposed at the end face of said container facing toward said stem, and guide rods disposed above and under the seal block respectively, said guide rods being capable of sliding sidewardly and linearly on said seal block, whereby said seal block pieces are moved apart from and getting closer to each other by the guide rod and said cylinder.

19. An extruder as claimed in claim 10, wherein said ring-shape seal block is provided with gas outlets inside thereof for spraying coolant to said sealing members and for blowing off materials attached thereto.

* * * * *

# United States Patent

[11] 3,577,753

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Bethlehem;
Louis S. Schwartz, Schnecksville, Pa.

[21] Appl. No. 763,715
[22] Filed Sept. 30, 1968
[45] Patented May 4, 1971

[73] Assignee Bethlehem Steel Corporation

[54] METHOD AND APPARATUS FOR FORMING THIN-WALLED CYLINDRICAL ARTICLES
5 Claims, 6 Drawing Figs.

[52] U.S. Cl. ..... 72/41, 72/342, 72/349
[51] Int. Cl. ..... B21d 22/28, B21d 37/16, B21d 37/18
[50] Field of Search ..... 72/41, 42, 342, 347, 34 (B), 349; 113/120 (H)

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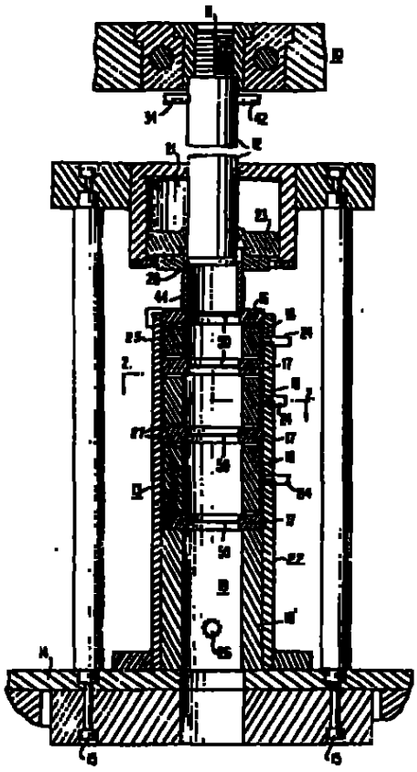
*Primary Examiner*—Lowell A. Larson
*Attorney*—Joseph J. O'Keefe

ABSTRACT: A method and apparatus for forming thin-walled containers from flat blanks is disclosed herein. The flat blanks are precoated with a dry film lubricant and drawn and ironed through a series of dies. Apparatus is provided to prevent the thermal breakdown of the lubricant comprising an internally fluid-cooled punch and fluid-cooled dies.



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PATENTED MAY 4 1971 3,577,753

SHEET 1 OF 2

FIG.1

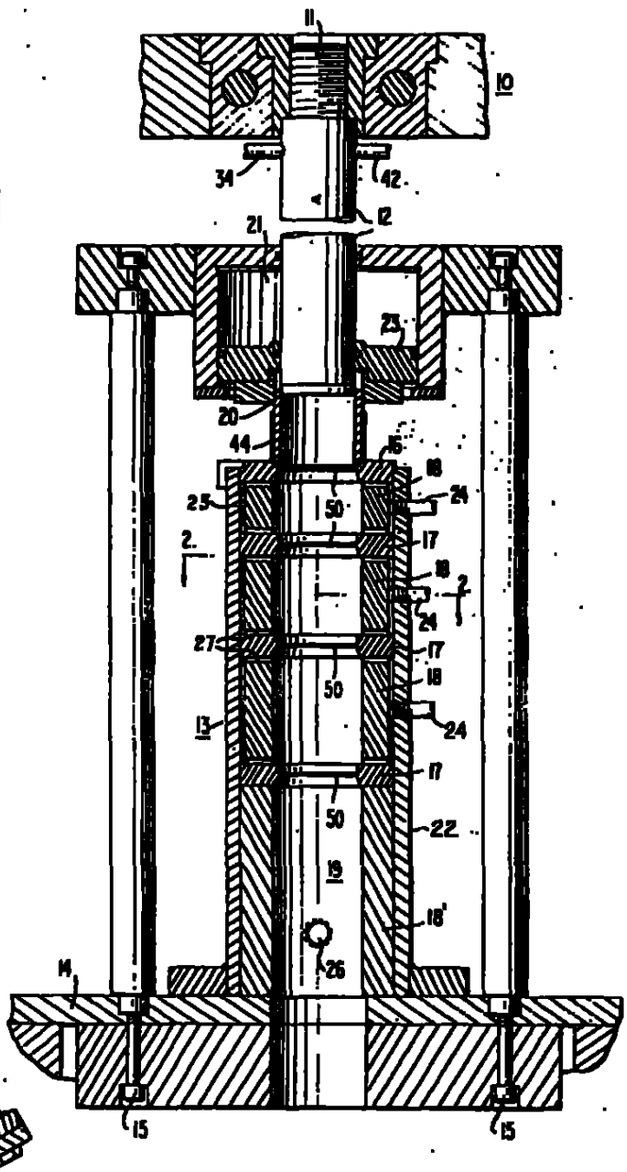
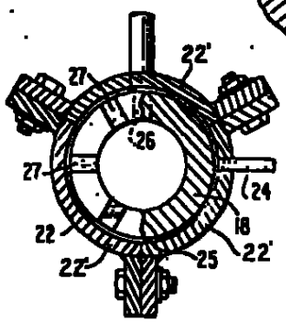



FIG.2

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PATENTED MAY 4 1971 3,577,753

SHEET 2 OF 2

FIG.3

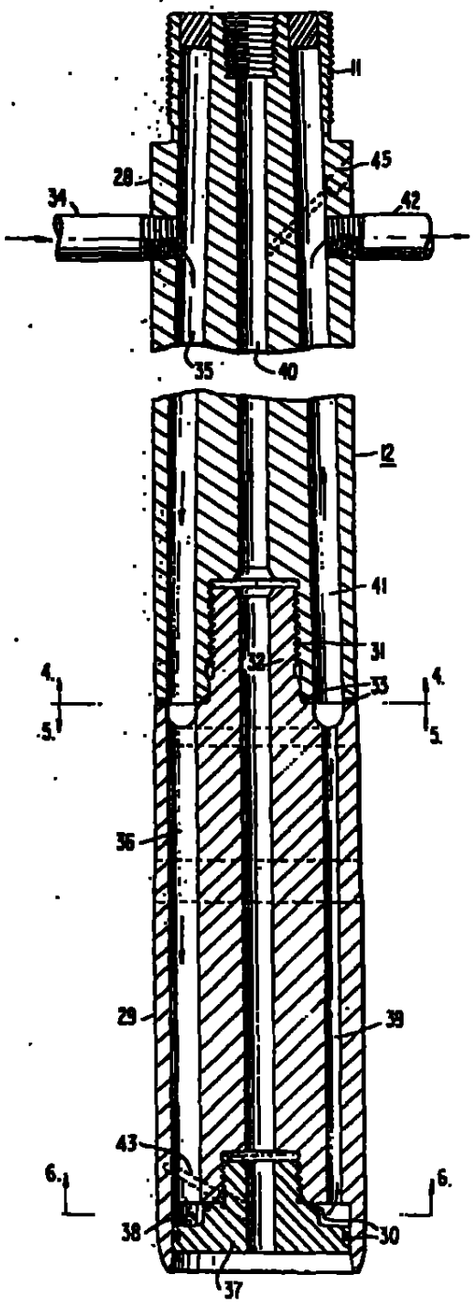



FIG.4

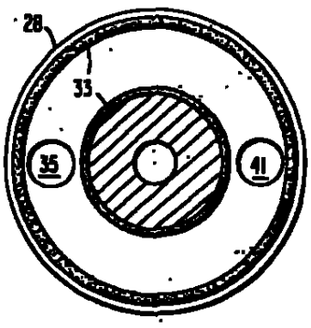



FIG.5

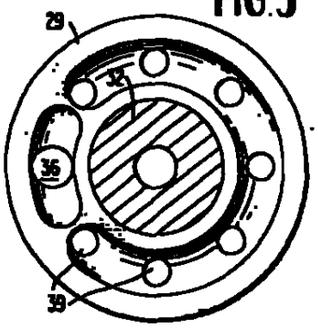
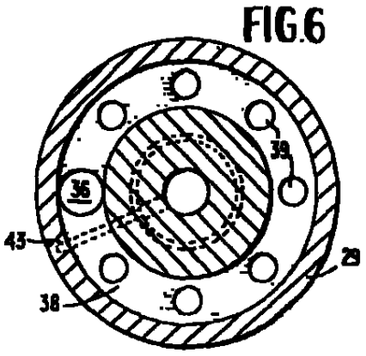



FIG.6

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# METHOD AND APPARATUS FOR FORMING THIN-WALLED CYLINDRICAL ARTICLES

## BACKGROUND OF THE INVENTION

This invention relates generally to the manufacture of seamless containers and more particularly to an improved method and apparatus for drawing and ironing said containers from flat metal blanks.

The manufacture of thin-walled cylindrical containers comprise steps including drawing, redrawing, and ironing of flat metal blanks. As referred to throughout this application the term "drawing" is applied to the operation which initially forms a shallow cup from the starting flat blank of metal. The shallow cup is produced when a punch forces the blank through a drawing die turning a peripheral portion of the blank upwardly and simultaneously smooths the sidewall thus formed. This operation does not result in any reduction of the blank, the thickness of the cup being the same as the thickness of the starting blank.

The term "ironing" refers to the operation of further forcing the drawn cup through an ironing die by means of a punch resulting in substantial reduction of the sidewall thickness thus elongating the cup. No appreciable reduction in diameter of the cup results from this operation.

Apparatus is known whereby flat blanks are drawn and ironed to form a metal container whose sidewall thickness is less than the thickness of the starting blank in a single stroke of the die punch. The die punch forces the blank through a plurality of spaced-apart drawing and ironing dies which are fixed in axial alignment with said punch in a holder. There are problems involved in the drawing and ironing of relatively thin gauge metal such as flat steel blanks, however, including the generation of frictional heat during movement of the punch through the forming dies and possible shearing and fracturing of the tubularlike workpiece. Also, conventional means for providing lubricant at each die station results in costly loss of lubricant and the residual liquid lubricant on the can must be removed by an additional processing step. Another problem of conventional drawing and ironing operations is the extensive die wear due to metal-to-metal contact between the dies and the blank.

It has been proposed to use a metal blank having a coating of dry film lubricant. However, the buildup of heat in conventional punch and die apparatus prevents such use because of the thermal breakdown of the lubricant. Therefore, the instant invention was developed to overcome this objection.

The primary object, therefore, of the present invention is to provide means for drawing and ironing thin-walled containers from blanks having a dry film lubricant coating without the thermal breakdown thereof.

A further object is to provide apparatus for producing thin-walled containers without fear of shearing or fracturing the metal.

A still further object is to provide apparatus for producing drawn and ironed articles without the addition of lubricant during the drawing and ironing process.

## SUMMARY OF THE INVENTION

The above objects are accomplished by providing fluid-cooled apparatus which is adapted to draw and iron a flat metal blank precoated with a dry film lubricant into a thin-walled cylindrical container. The apparatus is adapted to prevent the thermal breakdown of the lubricant and at the same time to cool the punch and dies.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of the apparatus of the instant invention,

FIG. 2 is a section through the die holder taken on line 2–2 of FIG. 1,

FIG. 3 is a detailed sectional view of the punch,

FIG. 4 is an enlarged sectional view through the punch taken on line 4–4 of FIG. 3,



FIG. 5 is an enlarged sectional view through the punch taken on line 5–5 of FIG. 3, and

FIG. 6 is an enlarged sectional view through the punch taken on line 6–6 of FIG. 3.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention will now be described in detail with particular reference to the drawings. FIG. 1 is a sectional view of the arrangement of the various elements of the apparatus of the invention. A reciprocable press ram 10 is adapted to receive the threaded end portion 11 of punch assembly 12. Die holder 13 which is affixed to the press bed 14 as, e.g., by bolts 15 comprises blank holder 20 and die jacket 22. Blank holder 20 is adapted to reciprocate within cylinder 21 by pneumatic means which operates piston 23 to which said blank holder is removably attached. The die jacket 22, which is seen in section in FIG. 2 comprises flanged segments 22' for easy removal, bolted to the press bed 14, and a set of dies including a redraw die 16 and three ironing dies 17 separated in a predetermined arrangement by spacers 18. The outside diameter of spacers 18 is somewhat smaller than the inside diameter of the jacket 22 to allow space for circulation of a cooling medium. As seen in FIG. 2 the spacers are provided with pins 25 located 90° apart on the outside diameter of the spacer and integral therewith to facilitate its alignment within the jacket and are further provided on top and bottom surfaces with radially disposed grooves 27 to allow a cooling medium to circulate around the dies. Conduits 24 supply each of the spacers with the cooling medium. The inside diameter of jacket 22 is slightly larger than the outside diameter of the dies to enable the dies to free float and thus aid in aligning the dies at the punch descends. Dies 16 and 17 are of conventional design each having an aperture 50 through which the punch passes. Filler 18' is provided at the bottom of the die jacket to support the dies and establish a chamber 19 for the purpose of receiving the completely drawn and ironed product. An opening (not shown) is provided in the lower section of one of the flanged segments for ejecting the cans sideways to a collecting station upon withdrawal of the punch. Conduit 26 supplies a blast of air to blow the can out of the chamber 19.

Referring now to FIG. 3 the punch assembly 12 is seen in longitudinal section and will be described in detail. The pictured embodiment discloses a two-piece punch comprising punch adapter 28 and punch body 29 which when assembled provides an internally fluid-cooled punch for drawing and ironing precoated metal blanks. The punch adapter 28 is provided with male threads 31 at one end thereof for attachment to the press ram 10. A female connection 31 at the other end of the punch adapter 28 is threaded to receive the upper male threaded end 32 of the punch body 29 to unite the punch parts into an operating unit. O-rings 33 at the interfaces of the connection provide a positive liquid seal between the mating surfaces of the punch body and adapter. A coolant is supplied through an inlet pipe 34 to a longitudinal bore 35 through the punch adapter 28 thence through a longitudinal bore 36 in the punch body 29. A plug 37 is adapted to receive the coolant and distribute it by means of an annular channel 38, FIG. 6, to seven radially spaced longitudinal bores or outlet holes 39 adjacent the surface of punch body 29, and somewhat smaller in diameter than the inlet bore 36. The base cap or plug 37 combines with O-rings 30 as a sealant to accommodate continuous flow of the cooling medium in the system. This arrangement provides effective cooling of the surface of the punch. The upper end of the punch body 29, see FIG. 5, is provided with a partial annular channel communicating with the upper or discharge ends of the outlet holes 39 for collecting the cooling medium and discharging it into outlet bore 41 which is a longitudinal bore in the punch adapter 28 substantially diametrically opposite aforesaid longitudinal bore 35, FIG. 4, and communicating with an outlet pipe 42.

The punch assembly 12 is further provided with a longitudinal bore 40 extending through the axis of the punch through which an air blast is directed to strip the drawn and ironed can off the punch as the press ram and punch start the return stroke. The punch body 29 is provided with a bore 43 at the lower end extending at an angle generally upwardly from the center bore 40 to a point just beneath the surface of the punch body for insertion of a thermocouple (not shown). Leads from the thermocouple are passed up the center bore 40 to angular bore 45 near the top of punch adapter 28. The leads exit from the punch through the bore 45 and then are attached to a device for recording the surface temperature of the punch body so that a substantially constant temperature of approximately 50° F. can be maintained on the surface.

The following description will point out with particularity the unique features of the present invention which provides means for deep-drawing and ironing thin cylindrical articles such as beer and beverage containers and the like. The starting blank is a flat circular piece of thin metal such a black plate or the like which is prepared in a conventional manner for the deep drawing operation by vapor degreasing and then cathodically cleaning the blank to remove the oxide film in order to achieve a strong chemical bond of the lubricant film with the metal surface. After cathodic cleaning, blanks are thoroughly rinsed in hot water and dried in an oven. The blanks are then coated with a lubricant film which may be composed of a phosphate coating and an organic lubricant applied in a single bath in which the blank is immersed for a sufficient length of time to insure proper bonding of the coating to the metal surfaces. The coated blanks are then dried in a drying oven to produce the desired dry film lubricant. Other lubricant coatings may also be used as e.g. soap lubricants omitting the phosphate coating or commercially known quick-drying lubricants which eliminate the drying step. However, it has been found that the best results are obtained when using the combination phosphate coating and organic lubricant.

In the pictured embodiment the coated blank 44 is a shallow cup preform produced in another press. This procedure was merely an expedient means of using available equipment. It will be understood by those skilled in the art, however, that this initial step can be included with the subsequent drawing and ironing steps in a one step, single-stroke operation.

The shallow cup blank 44 is fed to the press and is seated in the recess provided by the redraw die 16 at the top of the die holder 13. The blank holder 28 is actuated by the operator or on a signal activated responsive to the presence of the blank on the die holder 13 and moves downward from its retracted position to establish a predetermined holddown pressure. The punch 12 is then actuated to drive the precoated metal blank through the series of redraw 16 and ironing dies 17 to produce the desired end product. No other lubricant is applied to the blank during this redrawing and multiple ironing operation. When the punch 12 reaches the bottom dead center position, a microswitch-controlled air valve is triggered releasing an air blast through the center hole 40 in the punch assembly which strips the can off of the punch. When the punch passes a preselected position on its return stroke means is activated to



supply a side blast of air through air blast hole 26 at the bottom of die holder 13 to push the can out into a collecting station, thus making the press ready for the next cycle.

Cold air is circulated over the dies during the redraw and ironing operation to keep the dies cool as well as to supply a cooling medium to the outside surface of the container being drawn. A fluid coolant is also passed through the punch assembly as hereinbefore described in order to cool the surface of the punch body 29 maintaining an optimum temperature of said surface of about 50° F. Throttling devices are provided to control the flow of the fluid coolant in both areas. A thermocouple (not shown) is inserted in bore 43 to record the temperature of the punch body just beneath the surface thereof. It has been found that 50° F. is the desired temperature for the punch to prevent thermal breakdown of the dry film lubricant. An evenly textured dull gray can is thus produced and a minimum of die wear results from the absence of metal-to-metal contact due to the stability of the dry film lubricant on the metal blank maintained by the fluid cooled punch of the instant invention.

The instant invention, therefore, provides a practical method for drawing and severe ironing flat metal blanks into predetermined configuration by a unique tooling system. The novel means employed for cooling the punch and blank results in a highly acceptable product which is readily adaptable to subsequent processing such as the application of enameling.

We claim:

1. A method of drawing and ironing thin-walled cylindrical articles from a flat blank comprising the steps of:
   a. coating said blank with a dry film lubricant,
   b. forcing said blank through a series of drawing and ironing dies, and
   c. maintaining the surface temperature of said blank less than the breakdown temperature of said lubricant.

2. The method according to claim 1 wherein the provision of step (c) includes cooling the working surface of said punch.

3. The method according to claim 2 further including cooling said series of drawing and ironing dies during the die stroke.

4. In apparatus for multiple stage drawing and ironing of thin-walled cylindrical articles from a flat blank coated with a dry film lubricant, the improvement comprising, in combination:
   a. an internally fluid-cooled punch,
   b. a first die and a second die, each of said dies having an aperture,
   c. spacer means to maintain said first die and said second die in spaced relation, said spacer means having a passage in alignment with said first and second die apertures, and
   d. means to pass a cooling fluid into said spacer means passage to cool said blank as it is drawn through said spacer means passage.

5. Apparatus according to claim 4 wherein said punch is provided with a plurality of radially spaced longitudinal bores adjacent the surface of said punch adapted to receive a circulating cooling medium.

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(12) **United States Patent**
**Ohnishi et al.**

(10) **Patent No.: US 6,216,511 B1**
(45) **Date of Patent: Apr. 17, 2001**

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(54) **APPARATUS AND METHOD FOR SMOOTHING A WELDED SEAM OF STEEL PIPE**

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(73) Assignee: **Kawasaki Steel Corporation, Hyogo (JP)**

( * ) Notice: **Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.**

(21) Appl. No.: **09/049,193**

(22) Filed: **Mar. 27, 1998**

(30) **Foreign Application Priority Data**

Mar. 28, 1997 (JP) ..... 9-076639
Aug. 25, 1997 (JP) ..... 9-228178

(51) Int. Cl.[7] ..... B21D 51/28; B21D 1/08; B21B 17/02

(52) U.S. Cl. ..... 72/113; 72/208; 72/370.01; 72/52

(58) Field of Search ..... 72/113, 51, 52, 72/97, 150, 193, 208, 209, 370.01, 201, 200, 202; 228/125

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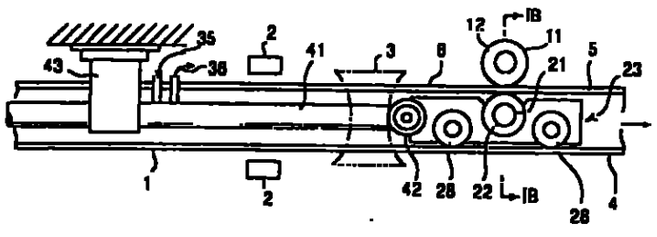
*Primary Examiner*—Rodney A. Butler
(74) *Attorney, Agent, or Firm*—Young & Thompson

(57) **ABSTRACT**

A method and apparatus for smoothing a thick walled portion of a steel pipe produced by pressure-welding two opposite longitudinal edges of an open pipe with a squeeze roll after being subjected to induction heating. Outer and inner reduction rollers pressure sandwiches the thick walled portion from the outer and inner surfaces of the pipe, a support supports the inner reduction roller to be rotatable and containing a water passage for cooling water, a connecting rod connects the support device to a coupler and contains a further water passage for feeding cooling water to the water passage, and an anchor holds the connecting rod In the a method of producing steel pipes two opposite longitudinal edges of the open pipe are preformed before being subjected to the induction heating and thereafter a thick walled portion is smoothed by the above-described apparatus.

**13 Claims, 9 Drawing Sheets**



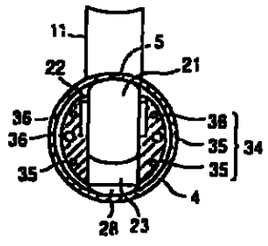



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FIG. 1A

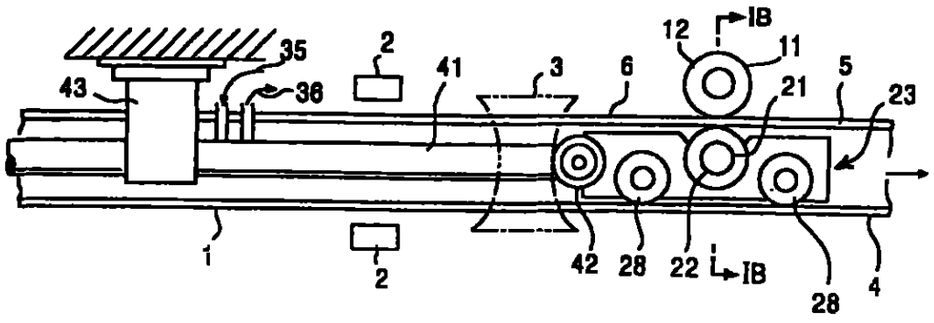


FIG. 1B

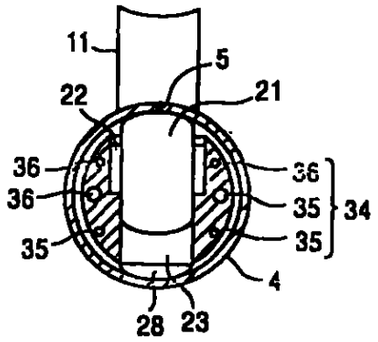

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FIG. 2

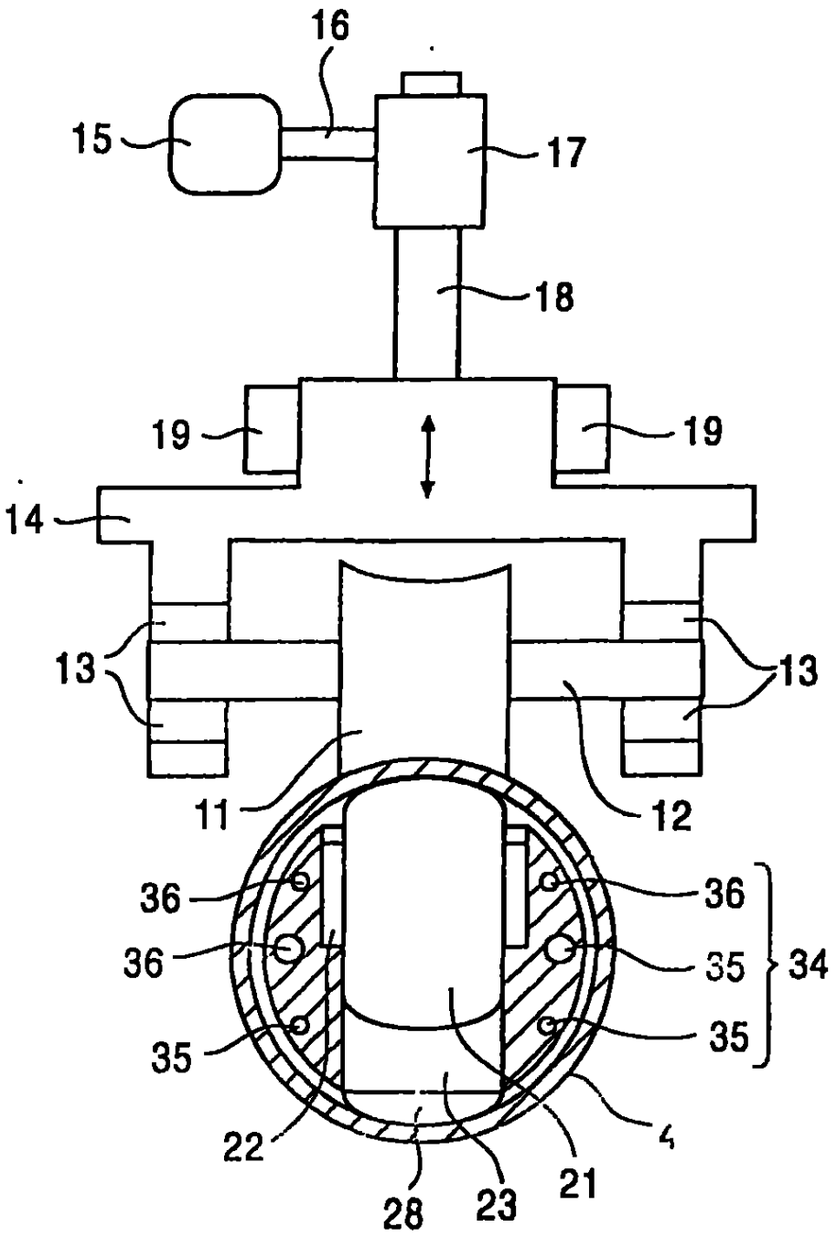

FIG. 3

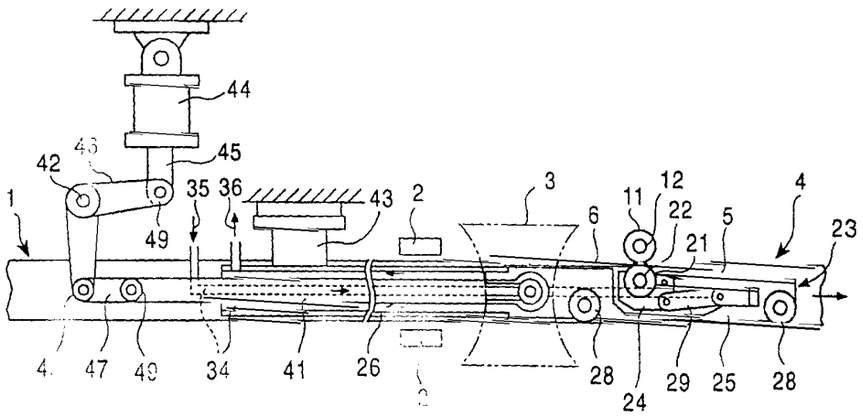
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FIG. 4

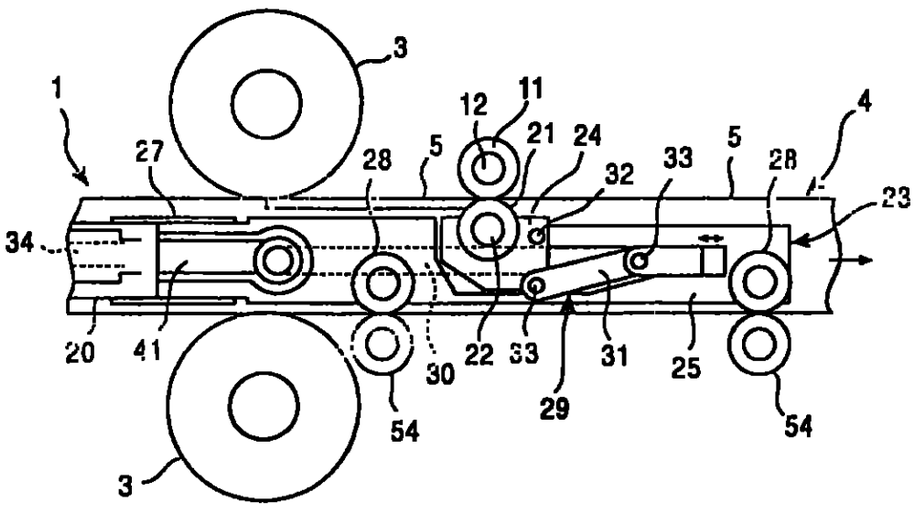

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FIG. 5A

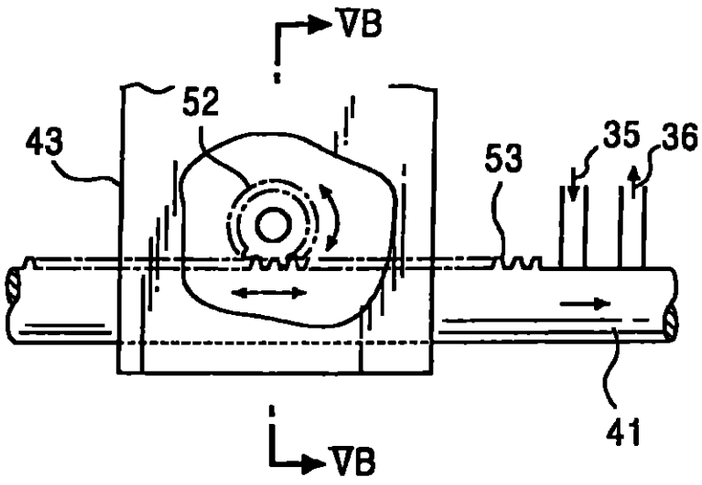


FIG. 5B

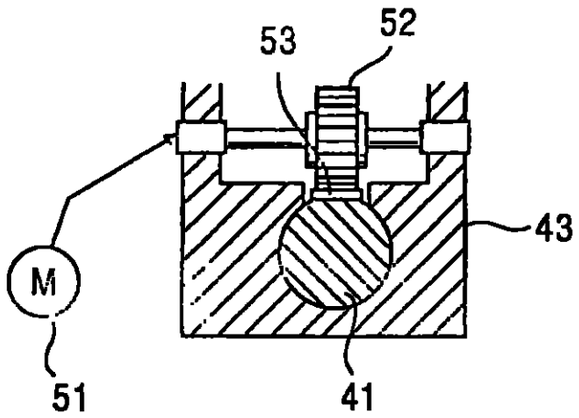

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FIG. 6

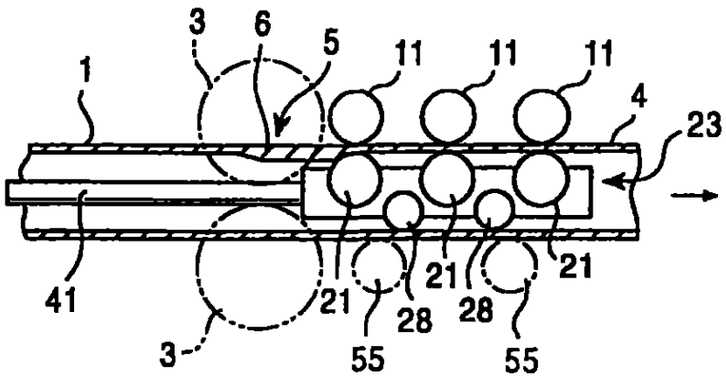
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FIG. 7

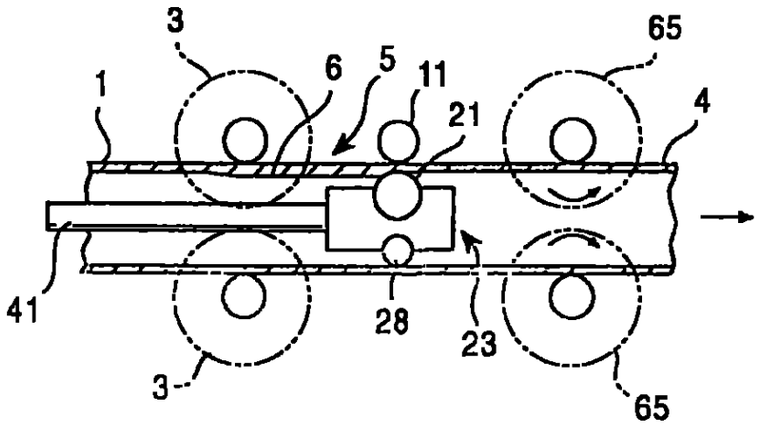
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FIG. 8A

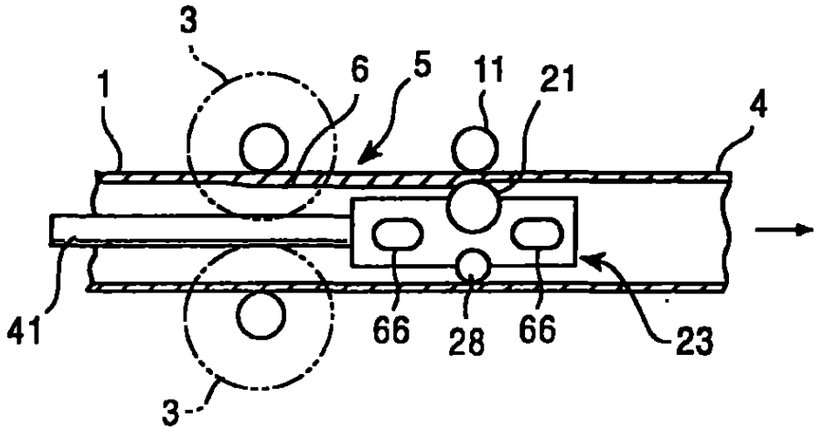



FIG. 8B

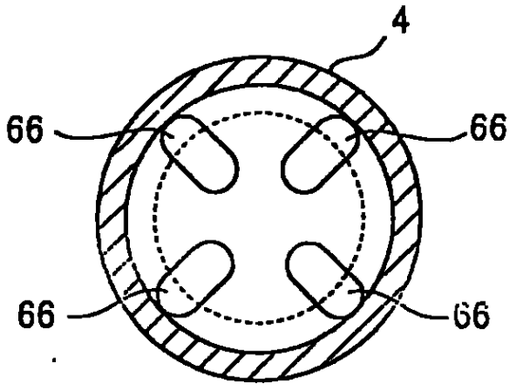


FIG. 9A

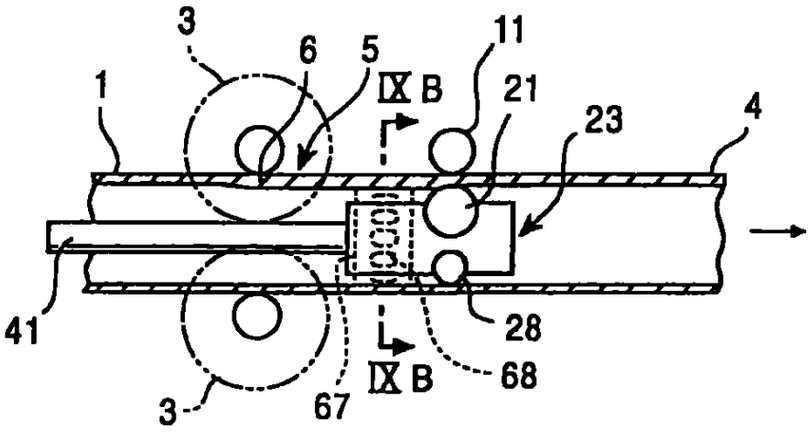



FIG. 9B

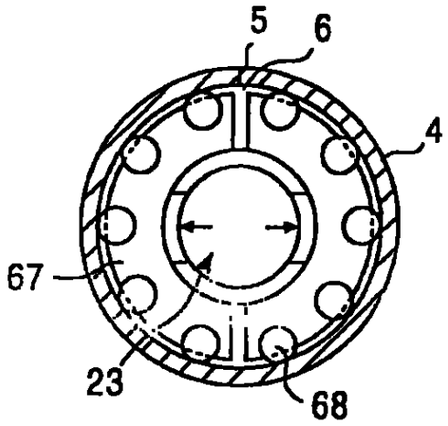


FIG. 10A

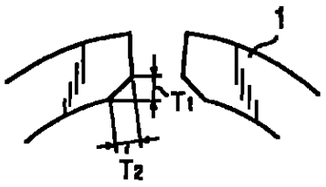



FIG. 10B

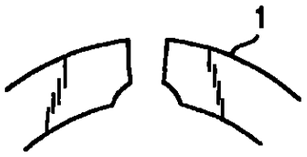



FIG. 11

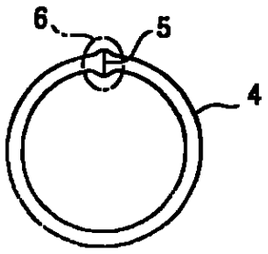
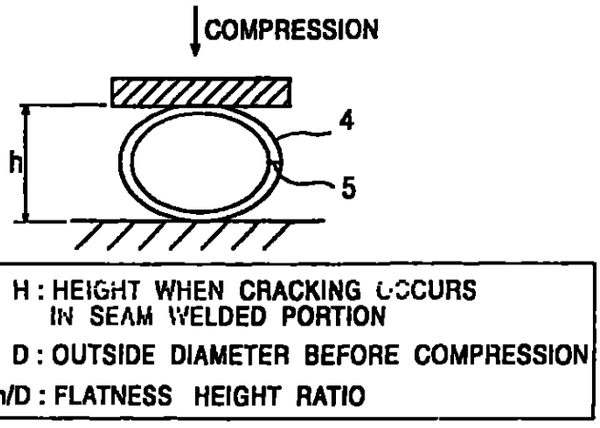



FIG. 12



# APPARATUS AND METHOD FOR SMOOTHING A WELDED SEAM OF STEEL PIPE

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates to an apparatus and a method for smoothing a welded seam of a steel pipe. More particularly, the present invention relates to a method and apparatus for smoothing a welded seam of steel pipe by successively subjecting a steel strip in a welded pipe production line to cylindrical shaping with a forming roll to form an open pipe, and smoothing in the production line a thick walled portion of the pipe that has been pressure-welded in a proper temperature range of solid-phase pressure-welding.

### 2. Description of the Related Art

Welded steel pipes are produced by subjecting a steel sheet or a steel strip to cylindrical shaping and then to seam welding. Methods of producing such steel pipes can be roughly divided into electric resistance welding, forge welding, and electric arc welding according to outside diameters and uses.

Steel pipes having small to medium outside diameters are produced by an electric resistance welding method utilizing high-frequency induction heating. This welding method is devised to cylindrically form a steel strip with a forming roll into an open pipe that is then heated at ends of two opposite longitudinal edges by means of high-frequency induction heating at a temperature above the melting point of the steel. These opposed end faces of the open pipe are subsequently butt-welded with a squeeze roll to form an electric resistance welded steel pipe. See, for example, Vol. 3 (3) pp. 1056 to 1092 of the third edition of Handbook of Steel.

One of the problems with this method is that when the opposite longitudinal edges of the open pipe are heated to a temperature higher than the melting point of the steel, molten steel flows under the influence of electromagnetic force forming an oxide that invades the welded seam. This has a tendency to or causes weld defects and molten steel splashes.

In order to overcome this problem, a method of producing an electric resistance welded steel pipe having two heaters is proposed in Japanese Unexamined Patent Publication No. 2-299782. A first heater heats opposite longitudinal edges of an open pipe to a temperature higher than the Curie point, and a second heater further heats the edges to a temperature higher than the melting point of the steel. Thereafter, two opposite longitudinal edges are butt-welded by a squeeze roll provided immediately downstream of the heaters to produce a steel pipe. In addition, Japanese Unexamined Patent Publication No. 2-299783 proposes an apparatus for producing an electric resistance welded steel pipe in which two opposite longitudinal edges of an open pipe are pre-heated with a current of a 45 to 250 kHz frequency applied by a first heater, and then two opposite longitudinal edges are further heated to a temperature higher than the melting point of the steel by a second heater and butt-welded with a squeeze roll.

These methods of producing electric resistance welded pipes teach heating two opposite longitudinal edges of the open pipe in a uniform manner, but the resulting flow of molten steel suffer may cause beads to form on inner and outer surfaces of the pipe during butt-welding because two opposite longitudinal edges of the open pipe are heated to a temperature higher than the melting point of the steel. The beads on the inner and outer surfaces should be removed after butt-welding. This removal is usually conducted by the use of a bead-cutting tool.



However, the bead-cutting tool causes additional problems. The time needed to replace the bead-cutting tool can be long due to adjustments in the amount to be cut, and wear or damage to the bead-cutting tool. This problem is especially severe when producing pipe at a high speed exceeding 100 m/min, which reduces the life of the bead-cutting tool and thus forces frequent replacement. For this reason, the pipe production line may be unproductive for prolonged periods.

Consequently, bead cutting imposes a bottleneck on production of welded steel pipes and prevents higher productivity.

On the other hand, a highly productive method of making a forge-welded steel pipe is also known to be suited for the formation of a steel pipe of a relatively small diameter. This method heats a successively supplied steel strip to a temperature about 1,300° C. in a heating furnace and thereafter subjects the steel strip to cylindrical forming with a forming roll into an open pipe. High-pressure air is sprayed on two opposite longitudinal edges of the open pipe to descale the edges, and then oxygen is sprayed onto the edges with a welding horn. The temperature of the edges is increased to about 1,400° C. by the oxidation heat and thereafter the edges are butt-welded and solid-phase welded by a forge welding roll to form a steel pipe. See, for example, Vol. III (3), pp. 1093 to 1109 of the third edition of Handbook of Steel.

However, this method is not without problems. Since the two opposite longitudinal edges of the open pipe surfaces are not sufficiently descaled, scales get into the butt welded portion, and the strength of the seam is considerably inferior to that of the base material. For example, the electric resistance welded steel pipe achieves a flatness-height ratio h/D of 2/D (with reference to FIG. 12, h is the height of the pipe when cracking occurs in the welded seam when the pipe is compressed and D is the outside diameter before compression, and where t is steel thickness), whereas the forge welded steel pipe can achieve a flatness-height ratio h/D of only about 0.5. In addition, the steel strip is heated to a high temperature, so that scales are produced on the surface of the pipe, thereby degrading the surface texture.

The forge welding method has a higher productivity than the electric resistance welding method due to its high pipe producing speed of 300 m/min or higher, but has poor seam quality and surface texture. For this reason, the forge welded steel pipe cannot be applied to a steel pipe requiring high strength reliability and surface quality, such as STK of JIS (Japanese Industrial Standards) or the like. In order to solve the above problems, the present inventors have devised a solid-phase pressure-welding pipe production method. In this method, two opposite longitudinal edges of the open pipe is subjected to induction heating (hereinafter, referred to as edges preheating) in the temperature range (hereinafter, referred as the preheating temperature range) higher than the Curie point (about 770° C.) but below the melting point of the pipe. Then, a uniform temperature of two opposite longitudinal edges is ensured within the preheating temperature range by air cooling and thereafter two opposite longitudinal edges of the open pipe are pressure-welded by being subjected to the induction heating (hereinafter, referred to as the real heating) in a proper temperature range of solid-phase pressure-welding (1,300 to 1,500° C.). The steel pipe

produced by the solid-phase pressure-welding pipe production method requires no bead cutting unlike the conventional welded pipe, so that it can be produced by high pipe producing speed and has high productivity, and more over, causes no deterioration in the seam quality and surface texture due to oxidation. As shown in FIG. 11, however, a thick walled portion 6 that protrudes 5% or more of the thickness of the pipe 4 may be generated on a welded seam 5 of a solid-phase pressure-welded steel pipe 4 due to the temperature of the edges or degree of squeezing by the squeeze roll. Thick walled portion 6 is undesirable because it degrades the workability of the welded steel pipe, such as screw cutting, and promotes thickness deviation, such as inner surface angularity when squeeze-rolling the steel pipe.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide an apparatus and a method for smoothing a welded seam of steel pipe that effectively smooths a thick walled portion of a steel pipe produced by a solid-phase pressure-welding pipe production method.

The present invention has been completed by the following consideration.

In the conventional electric resistance welded steel pipe, two opposite longitudinal edges of the open pipe are heated by means of induction heating at a temperature higher than the melting point, so that molten steel is discharged onto the inner and outer surfaces of the pipe during butt-welding to form beads. The beads are removed by a bead-cutting tool.

In contrast, according to the present invention, two opposite longitudinal edges of the open pipe are heated by means of induction heating in a temperature below the melting point, and then pressure-welded by a squeeze roll. A thick welded portion formed on a weld seam can be collapsed by rolls because it is not melted. However, when the beads of the conventional electric resistance welded steel pipe are to be collapsed by the rollers, the beads are adhered to the rollers to prevent the rotation thereof, making it impossible to remove the beads by collapsing.

Accordingly, an embodiment of the apparatus of the present invention includes outer and inner reduction rollers for smoothing the thick walled by applying pressure to outer and inner surfaces of the pipe, a support for supporting the inner reduction roller to be rotatable and containing a water passage for cooling water, a connecting rod for connecting the support to a coupler and containing a further water passage for feeding cooling water to the water passage, and an anchor for holding the connecting rod.

An embodiment of the method of the present invention includes the steps of successively subjecting a steel strip to shaping with a forming roll to obtain an open pipe, heating two opposite longitudinal edges of the open pipe to a temperature range below the melting point by induction heating, and pressure-welding two opposite longitudinal edges of the open pipe with a squeeze roll, and thereafter, smoothing the thick walled portion with the above apparatus.

Other features and objects of the present invention will be apparent to those of skill in the art from the following description of preferred embodiments when read in light of the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a schematic side sectional view showing a smoothing apparatus according to a first embodiment of the present invention;

FIG. 1B is a front sectional view of FIG. 1A taken along the line 1B—1B;

FIG. 2 is a schematic front sectional view showing a smoothing apparatus according to a second embodiment of the present invention;

FIG. 3 is a schematic side sectional view showing a smoothing apparatus according to a third embodiment of the present invention;

FIG. 4 is an enlarged view of the right hand portion of FIG. 3;

FIG. 5A is a schematic side sectional view showing a device for moving an inner reduction roller in the pipe axial direction in a smoothing apparatus according to a fourth embodiment of the present invention;

FIG. 5B is a front sectional view of FIG. 5A taken along the line A—A;

FIG. 6 is a schematic side sectional view showing a smoothing apparatus according to a fifth embodiment of the present invention;

FIG. 7 is a schematic side sectional view showing a smoothing apparatus according to a sixth embodiment of the present invention;

FIG. 8A is a schematic side sectional view showing a smoothing apparatus according to a seventh embodiment of the present invention;

FIG. 8B is a front sectional view of FIG. 8A;

FIG. 9A is a schematic side sectional view of a smoothing apparatus according to an eighth embodiment of the present invention;

FIG. 9B is a front sectional view of FIG. 9A taken along the line A—A;

FIGS. 10A and 10B are sectional views each showing an example of the preformed shape of both edges of an open pipe;

FIG. 11 is an illustration showing a state of thick walled portion generated on a weld seam; and

FIG. 12 is an illustration of a flattening test procedure.

## DESCRIPTION OF PREFERRED EMBODIMENTS

A basic smoothing apparatus according to a first embodiment of the present invention will be described with reference to FIGS. 1A and 1B. FIG. 1A illustrates the thick walled portion 6 being smoothed, in which two opposite longitudinal edges of open pipe 1 formed by subjecting a steel strip to cylindrical shaping are induction-heated by work coil 2 and then pressure-welded by squeeze roll 3 to form steel pipe 4.

An embodiment of the present invention includes an outer reduction roller 11 and an inner reduction roller 21 for smoothing thick walled portion 6 by pressure sandwiching outer and inner surfaces of the pipe, a support device 23 for supporting inner reduction roller 21 to be rotatable and containing a water passage 34 for cooling a cooling liquid (typically water, although other suitable liquids may be used), a connecting rod 41 for connecting support device 23 to a coupler 42 and feeding the cooling water to water passage 34, and an anchor 43 for holding connecting rod 41.

With further reference to FIG. 2, outer reduction roller 11 is rotatably fitted to a support frame 14 by shaft 12 to contact the outer surface of steel pipe 4. Inner reduction roller 21 is rotatably fitted to support device 23 by roller pin 22 to come into contact with the inner surface of steel pipe 4. Support device 23 contains water passage 34 for feeding cooling

water. Water passage 34 may include advance passages 35 and return passages 36. Cooling water may be oil or cooling medium. In addition, support device 23 has receiving rollers 28 at its lower portion for receiving a rolling reaction force of inner reduction roller 21 by abutment with the inner surface of the pipe. Receiving rollers 28 may be shoes. Connecting rod 41 is located upstream of a pipe production line by means of coupler 42 connected to support device 23 at its front end and fitted to anchor 43 outside of open pipe 1 at its rear end. Connecting rod 41 includes an extension of water passage 34 that is connected to water passage 34 in support device 23 through coupler 42.

A second embodiment of the smoothing apparatus according to the present invention will now be described with further reference to FIG. 2. The apparatus of this embodiment can control the upward and downward movement of outer reduction roller 11.

Outer reduction roller 11 is rotatably fitted to support frame 14, which is provided on the outer surface of steel pipe 4, through shaft 12 and bearings 13. Further, outer reduction roller 11 can be moved up and down by a motor 15, a motor shaft 16, a jacking section 17, a screw shaft 18 and a sliding section 19 placed on support frame 14. Inner reduction roller 21 may have the same construction as that of the first embodiment.

A third embodiment of the smoothing apparatus according to the present invention will be described with reference to FIGS. 3 and 4. The apparatus of this embodiment can control the up and down movement of inner reduction roller 21.

Support device 23 consists of a frame portion 25 for supporting bearing 24, and a rod 26 portion extending toward open pipe 1 which are connected by a joint 27. Anchor 43 fitted near the tail end of rod portion 26 is passed through a slit in open pipe 1 to be affixed outside of the open pipe 1, whereby support device 23 is held at a predetermined position in open pipe 1. The position is such that inner reduction roller 21 and outer reduction roller 11 can be located on opposite sides of the thick walled portion 6.

On the other hand, bearing 24 is connected to the connecting rod 41 through a link mechanism 29. Link mechanism 29 includes a link arm 30 supported by frame portion 25 so as to be axially slidable in the pipe, and a link lever 31 for linking link arm 30 and bearing 24 through movable pins 33 on both ends thereof. The length of link lever 31 is designed and both of movable pins 33 are placed so that the displacement of link arm 30 in the pipe axial direction is converted into a radial displacement of bearing 24 toward outer reduction roller 11. Bearing 24 is connected to the tip of connecting rod 41 at the tail end of link arm 30.

Connecting rod 41 is passed through rod portion 26 to be connected to a rolling force generator 44 at its tail end. Although the invention may use other conventional force generators, rolling force generator 44 is preferably a hydraulic cylinder affixed outside of the pipe. An L-shaped lever 46 secured at its center portion by a fixed pin 48 may be provided at a position between a cylinder rod 45 and the tail end of connecting rod 41 where it passes through the slit portion of open pipe 1. Then, one end of L-shaped lever 46 may be secured to cylinder rod 45 by movable pin 49 and the other end is secured to the tail end of the connecting rod 41 by further movable pins 49 through an auxiliary arm 47.

Rolling force generator 44 may also be an electric motor, an air cylinder, etc. In the case of the electric motor, a convertor for converting rotational action of the rotary shaft of the motor into reciprocating action is additionally required. Such a convertor may be easily constructed by the use of a known mechanical component, such as a crank.

With this arrangement, the rolling force generated in rolling force generator 44 causes connecting rod 41 to be displaced in the pipe axial direction, and the displacement is converted by link mechanism 29 into the displacement of bearing 24, i.e., the displacement of inner reduction roller 21 in the up and down direction of the drawing. This allows a rolling force for suitably smoothing thick walled portion 6 to be imparted to inner reduction roller 21 from the slit portion of open pipe 1. The rolling force of inner reduction roller 21 is sufficient to smooth thick walled portion 6.

In this embodiment, when connecting rod 41 is moved backward (moved to the tail end side) by moving forward cylinder rod 45, link lever 31 is rotated in the clockwise direction about movable pin 33 on the side of link arm 30, and bearing 24 is rotated in the clockwise direction about fixed pin 32 in FIG. 4, inner reduction roller 21 is pressed toward thick walled portion 6. The rolling force corresponds to the advance distance of cylinder rod 45.

Receiving rollers 28 shown in FIGS. 3 and 4 receive the rolling reaction force to press the pipe wall. When steel pipe 4 has a low rigidity and there is a risk of deforming the pipe body, guide rollers 54 for imparting a reaction force to receiving rollers 28 through the pipe wall may be preferably provided, as shown in FIG. 4.

In addition, it is economical to use steel as a material for support device 23. However, since rod portion 26 is placed within the magnetic field influence area of work coil 2, it is highly possible that an induced current flows will heat and soften support device 23. Thus, water passage 34 is provided inside frame portion 25 and rod portion 26 to provide a flow of cooling water, as shown in FIG. 3. Referring to FIG. 3, water passage 34 is a double structure such that connecting rod 41 serves as advance passages 35 and rod portion 26 serves as return passages 36. The cooling water is fed from the tail end to advance passage 35 that communicates with return passages pipe 36 at the front end, and the cooling water is discharged at the tail end.

In addition, squeeze roll 3 is preferably placed so as to abut welded seam 5, as shown in FIG. 4. The generation of thick walled portion 6 outside the pipe can be avoided by allowing squeeze roll 3 to abut thick walled portion 6, thereby reducing the load on outer reduction roller 11.

A fourth embodiment of the smoothing apparatus according to the present invention will be now be described with reference to FIGS. 5A and 5B. In this embodiment, the smoothing apparatus is provided with a device for moving pipe-inner-surface reduction roller 21 shown in FIG. 1 or 3 in the pipe axial direction.

Support device 23 having inner reduction roller 21 mounted thereon is connected to connecting rod 41 by coupler 42, and connecting rod 41 is attached to anchor 43. A guide tooth 53 extending in the pipe axial direction is provided on the outer surface of connecting rod 41, and a drive gear 52 is meshed with the guide tooth 53. Drive gear 52 is connected to a motor 51, and allows inner reduction roller 21 to move by moving connecting rod 41 in the pipe axial direction. Advance passage 35 and return passage 36 are provided inside connecting rod 41.

Since thick walled portion 6 can be easily smoothed by being depressed at higher temperature, outer and inner reduction rollers 11 and 21 are placed as close as possible to squeeze roll 3. Outer and inner reduction rollers 11 and 21 may be preferably placed on the outgoing side of squeeze roll 3 where the temperature of welded seam 5 is not lower than about 900° C.

A fifth embodiment of the smoothing apparatus according to the present invention will now be described with refer-

sence to FIG. 6. FIG. 6 is a side sectional view of a smoothing apparatus in which outer and inner reduction rollers 11 and 21 are arranged in tandem in the pipe axial direction.

As shown in FIG. 6, a plurality of outer reduction rollers 11 are arranged on the outer surface of the pipe downstream of squeeze roll 3. In addition, a plurality of inner-surface reduction rollers 21 are arranged at positions where they can oppose outer reduction rollers 11 with thick walled portion 6 provided therebetween, and are rotatably mounted on support device 23. With this arrangement, the load on one roller can be reduced. In addition, the size of support device 23 can be reduced, so that the smoothing apparatus can be applied to a welded steel pipe of a small outside diameter. Further, by arranging respective sets of outer and inner reduction rollers 11 and 21 in such a manner that they are staggered in the pipe circumferential direction, thick walled portion 6 can be positively rolled without increasing the width of the rollers even if thick walled portion 6 winds more or less.

A sixth embodiment of the smoothing apparatus according to the present invention will now be described with reference to FIG. 7. In this embodiment, the smoothing apparatus includes support device 23 placed in the pipe on the outgoing side of squeeze roll 3, inner reduction roller 21 supported by support device 23 to smooth thick walled portion 6, outer reduction rollers 11 opposing inner reduction roller 21 through welded seam 5, and pinch rollers 65 which are rotated near the downstream of outer reduction roller 11 by abutment with the outer surface of the pipe to impart a longitudinal tensile force to steel pipe 4. To impart the longitudinal tensile force to steel pipe 4, pinch rollers 65 may be rotated at a peripheral velocity higher than that of squeeze roll 3 to advance steel pipe 4. Imparting the longitudinal tensile force to steel pipe 4 stimulates a longitudinal flow of metal, thereby preventing the generation of a stepped portion in the thick walled portion 6.

A seventh embodiment of the smoothing apparatus according to the present invention will now be described with reference to FIGS. 8A and 8B. In this embodiment, the smoothing apparatus includes support device 23 placed in the pipe on the outgoing side of squeeze roll 3, inner reduction roller 21 supported by support device 23 to smooth thick walled portion 6, and outer reduction rollers 11 opposing inner reduction roller 21 through welded seam 5. In addition, the apparatus includes a plurality of inner pressing rollers 66 provided on support device 23 near inner reduction roller 21 for pressing the inner surface of the pipe to impart a circumferential tensile force to steel pipe 4. Pressing forces of inner pressing rollers 66 can be imparted by, for example, a hydraulic cylinder through support device 23. Imparting the longitudinal tensile force to steel pipe 4 stimulates a longitudinal flow of metal, thereby preventing the generation of a stepped portion in thick walled portion 6.

An eighth embodiment of the smoothing apparatus according to the present invention will now be described with reference to FIGS. 9A and 9B. In this embodiment, the smoothing apparatus includes support device 23 placed in the pipe on the outgoing side of squeeze roll 3, inner reduction roller 21 supported by support device 23 to smooth thick walled portion 6, and outer reduction rollers 11 opposing inner reduction roller 21 through welded seam 5. In addition, the smoothing apparatus includes a pipe-expanding tool 67 supported by support device 23 to expand the pipe circumference by pressing the inner surface of the pipe on the outgoing side of squeeze roll 3. Pipe-expanding tool 67 includes rollers 68 to prevent the generation of inner surface flaws due to rubbing against the inner surface of the pipe. A pressing force of pipe-expanding tool 67 can be imparted by, for example, a hydraulic cylinder through support device 23. This allows welded seam 5 to be pulled in the circumferential direction and subjected to inner surface rolling after thick walled portion 6 is plastically deformed to reduce its thickness, so that the collapsed volume is reduced and the welded seam can be smoothed.

In the apparatus for smoothing the welded seam of steel pipe described above, when the outside diameter of steel pipe 4 is changed, outer reduction roller 11, inner reduction roller 21, support device 23 and so forth provided downstream of coupler 42 may be replaced with those having the sizes corresponding to the outside diameter after replacement.

When thick walled portion 6 is rolled by outer reduction roller 11 and inner reduction roller 21, a bending stress of 15 kg/mm or more is generated by a reaction force from the pipe. In addition, the temperature difference between an area near the pressure-welded point of the surface of the roller abutting the pipe and other areas frequently reaches 150° C. or higher.

Therefore, in order to extend the life of the rollers, the materials for the rollers may be preferably selected from those having a bending strength of 150 kg/mm$^2$ or more, and a heat shock-resistant temperature difference of 150° C. or higher. The heat shock-resistant temperature difference refers to the temperature difference which does not produce cracking in a test piece of a square bar of 3 mm×4 mm×40 mm (the specification for JIS four-point bending test) when the sample is dropped into water after being heated to a predetermined temperature (the difference between the heating temperature and the water temperature).

In light of the present levels of technology, silicon nitride ($Si_3N_4$) based ceramics, silicon carbide (SiC) based ceramics, zirconium oxide ($ZrO_2$) based ceramics, or aluminum oxide ($Al_2O_3$) based ceramics are most desirable for the materials.

A method of producing welded steel pipes according to the present invention will now be described.

The method according to the present invention may include the steps of successively subjecting a steel strip to shaping with a forming roll to obtain an open pipe, heating two opposite longitudinal edges of the open pipe to a temperature range below the melting point by means of induction heating, and pressure-welding two opposite longitudinal edges of the open pipe by a squeeze roll, wherein edge ends to be inner surfaces of two opposite longitudinal edges of the open pipe are preformed before the pressure-welding by the squeeze roll. Thereafter, a thick walled portion is smoothed by a smoothing apparatus.

In this case, and with reference to FIGS. 10A and 10B, the edge ends that are to be inner surfaces of two opposite longitudinal edges of the open pipe are chamfered by an edge roll or cutting before the pressure-welding by the squeeze roll. The preformed shape of the preformed edge ends is not necessarily restricted to this shape, and the inside ends of two opposite longitudinal edges may be chamfered into a tapered shape, or a round shape by the length of $T_1$ in the thickness direction and by the length of $T_2$ in the pipe circumferential direction.

By preforming two opposite longitudinal edges of the open pipe before the pressure-welding by the squeeze roll, the size of the thick walled portion generated during butt-welding and connection by the squeeze roll can be reduced. This can reduce the load on the smoothing apparatus and increase pipe production speed.

The present invention will be more clearly understood with reference to the following examples:

## EXAMPLE 1

The smoothing apparatus shown in FIGS. 1 and 2 was installed in a steel pipe production line, and a carbon steel pipe an outside diameter of 21.7 to 60.5 mm a thickness of 1.6 to 3 mm (equivalent to SGP of JIS G3452, and STK of JIS G3444) was produced by a solid-phase pressure-welding pipe production method while smoothing thick walled portion 6.

In Example 1, silicon nitride based ceramics having a bending strength of 85 kg/mm$^2$, and a heat shock-resistant temperature difference of 800° C. were used for the materials of squeeze roll 3, outer reduction roller 11 and inner reduction roller 21 each abutting thick welded seam 6. In addition, during the operation of the apparatus of the present invention, cooling water was provided in the water passage 34 to maintain the temperature of the center portion of support device 23 at 200±15° C. The position of inner reduction roller 21 was fixed, and when the thickness of the pipe was changed, outer reduction roller 11 was moved in the steel pipe radial direction to control the spacing between inner reduction roller 21, thereby imparting a rolling force to inner reduction roller 21.

On the other hand, as a comparative example 1, a base pipe of the same specification and size was produced by a solid-phase pressure-welding pipe production method in a conventional pipe production line having squeeze rolls placed on both sides of a thick walled portion in which the welded seam was smoothed by bead cutting. Thereafter, the pipe was made by the same procedure as that of example 1.

As a result, according to the example 1, the maximum pipe producing speed during the solid-phase pressure-welding remarkably increased from 100 m/min in the comparative example 1 to 180 m/min, the seam quality (evaluated by an average value of flatness-height ratio h/D in a flattening test) remarkably increased from 0.5 (comparative example 1) to 2l/D, and the longitudinal thickness variation of the welded seam remarkably increased from −0.2 to +0.3 mm (comparative example 1) to ±0.05 mm. In addition, the surface texture was greatly improved.

## EXAMPLE 2

The smoothing apparatus shown in FIGS. 3 and 4 was installed in a steel pipe production line, and a carbon steel pipe having an outside diameter of 60.5 to 114.3 mm a thickness of 1.9 to 4.5 mm (equivalent to SGP of JIS G3452, and STK of JIS G3444) was produced by a solid-phase pressure-welding pipe production method while smoothing thick walled portion 6.

In Example 2, silicon nitride based ceramics having a bending strength of 85 kg/mm$^2$, a heat shock-resistant temperature difference of 800° C. were used for the materials of the squeeze roll 3, outer reduction roller 11 and inner reduction roller 21 each abutting thick walled portion 6. In addition, during the drive of the apparatus of the present invention, cooling water was provided in water passage 34 to maintain the temperature of the center portion of support device 23 at 200±15° C. The position of outer reduction roller 11 was fixed, and when changing the thickness of the pipe, inner reduction roller 21 was moved in the steel pipe radial direction to control the spacing between outer reduction roller 21, thereby imparting a rolling force to outer reduction roller 11.

On the other hand, as a comparative example 2, a base pipe of the same specification and size was produced by a solid-phase pressure-welding pipe production method in a conventional pipe production line having squeeze rolls placed on both sides of a thick walled portion in which the welded seam was smoothed by bead cutting. Thereafter, the pipe was made by the same procedure as that of example 2.

As a result, in the example 2, the maximum pipe producing speed during the solid-phase pressure-welding remarkably increased from 100 m/min of comparative example 2 to 150 m/min, the seam quality (evaluated by an average value of flatness-height ratio h/D in a flattening test) of the product pipe remarkably increased from 0.5 (comparative example 2) to 0.2, and the longitudinal thickness variation of the welded seam remarkably increased from −0.2 to +0.3 mm (comparative example 2) to ±0.15 mm. In addition, the surface texture was greatly improved.

While preferred embodiments of the present invention have been described, it is to be understood that the invention is to be defined by the appended claims when read in light of the specification and accorded their full range of equivalents, with changes and modifications being apparent to those of skill in the art.

What is claimed is:

1. An apparatus for smoothing a thick walled portion of a steel pipe that has been made by pressure-welding two opposite longitudinal edges of an open pipe with a squeeze roll after subjecting two opposite longitudinal edges to induction heating, the apparatus comprising:

outer and inner reduction rollers for applying pressure to opposing sides of the thick walled portion from respective outer and inner surfaces of the pipe;

a support supporting said inner reduction roller to be rotatable and comprising a water passage for cooling water and a coupler at one end thereof;

a connecting rod connecting said support to said coupler and containing a further water passage in fluid communication with said water passage;

a support frame for supporting said outer reduction roller, and means for moving said support frame in the steel pipe radial direction to control the spacing between said outer and inner reduction rollers; and

an anchor holding said connecting rod.

2. The apparatus of claim 1, wherein said support includes a bearing for rotatably supporting said inner reduction roller, means for generating a rolling force to be transmitted to said connecting rod and for displacing said bearing toward said outer reduction roller, and said bearing being connected to the connecting rod through a link mechanism structured and arranged to transmit the rolling force to said inner reduction roller via displacement of said bearing.

3. The apparatus of claim 1, wherein said outer and inner reduction rollers are arranged in tandem in the pipe axial direction.

4. The apparatus of claim 1, wherein the squeeze roll abuts the thick walled portion.

5. The apparatus of claim 1, further comprising guide rollers on an outer surface of the pipe for supporting said support through the pipe.

6. The apparatus of claim 1, wherein said anchor comprises means for moving said connecting rod in the pipe axial direction.

7. The apparatus of claim 1, further comprising pinch rollers for imparting a longitudinal tensile force to the pipe while rotating downstream of said outer reduction roller by abutment with the outer surface of the pipe.

8. The apparatus of claim 1, further comprising a plurality of inner surface pressing rollers for pressing the inner

surface of the pipe near said inner reduction roller to impart a circumferential tensile force to the pipe.

9. The apparatus of claim 1, further comprising a pipe-expanding tool supported by said support on an outgoing side of the squeeze roll to expand the pipe circumference by pressing the inner surface of the pipe.

10. The apparatus of claim 1, wherein said inner and outer reduction rollers comprise materials having a bending strength of at least 15 kg/mm$^2$, and a heat shock-resistance temperature difference of at least 150° C.

11. The apparatus of claim 10, wherein said materials are selected from the group consisting of silicon nitride based ceramics, silicon carbide based ceramics, zirconium oxide based ceramics, and aluminum oxide based ceramics.

12. An apparatus for smoothing a thick walled portion of a steel pipe, the apparatus comprising:

outer and inner reduction rollers for applying pressure to opposing sides of the thick walled portion from respective outer and inner surfaces of the pipe;

a force generator for providing a linearly directed force;

a support supporting said inner reduction roller to be rotatable;

an axially movable connecting rod connecting said support to said force generator and for conveying the linearly directed force from said force generator to said support;

said support comprising a linkage for translating the linearly directed force to an outwardly directed radial pressure.

13. The apparatus of claim 12, wherein the linearly directed force from said force generator is generally perpendicular to an axis of said connected rod, and further comprising a link for translating the linearly directed force into axial movement of said connecting rod.

* * * * *

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REPUBBLICA ITALIANA

Ministero
dell'Industria e del Commercio
UFFICIO CENTRALE DEI BREVETTI
per Invenzioni, Modelli e Marchi

# BREVETTO PER INVENZIONE INDUSTRIALE 499298

— classe IV



Alberto Calmes a Milano

*Dep*: 24 *marzo* 1953; *Des*: 10 *novembre* 1954

## Perfezionamenti nei mandrini di laminazione a raffreddamento interno e nelle disposizioni di adduzione agli stessi del fluido refrigerante

C. 80

Sono già stati proposti mandrini per la laminazione di tubi a. s. al treno detto a passo di pellegrino costruiti per l'alimentazione con acqua di raffreddamento dell'interno e dell'esterno dei mandrini stessi.

La presente invenzione ha per scopo di rendere più economica la costruzione e di aumentare la resistenza di un mandrino di tal genere e per oggetto un mandrino costituito da un corpo cilindrico cavo montato coassialmente su di un'anima cilindrica, pure cava, in modo da risultare solidale con essa, tra la quale ed il mandrino, oltrechè all'interno dell'anima viene fatta circolare l'acqua di raffreddamento, caratterizzato da ciò che la superficie esterna dell'anima è provvista di una serie numerosa di scanalature parallele formanti con la superficie interna del mandrino altrettanti canali chiusi correnti da un capo all'altro del mandrino e comunicanti con la cavità interna dell'anima attraverso fori radiali dell'anima stessa distribuiti su tutta la sua lunghezza, oltrechè attraverso l'estremità anteriore dell'anima.

Rispetto ai tipi noti lo spessore del mandrino può essere così fortemente ridotto senza indebolirne la resistenza allo schiacciamento, di modo che l'effetto di raffreddamento risulta notevolmente aumentato. Si ha inoltre una forte economia in materiale da mandrino per effetto della struttura tubolare del mandrino e parete interna cilindrica continua, facile ad ottenere con lo stesso treno di laminazione; praticando infatti le scanalature secondo le generatrici dell'anima, il mandrino può essere laminato direttamente sull'anima nella stessa laminazione del pellegrino; d'altra parte l'anima diventa un pezzo ricuperabile per l'uso continuo dopo l'usura del mandrino.

L'invenzione ha anche per oggetto una particolare disposizione di adduzione della acqua di raffreddamento al mandrino, consistente in un tubo disposto sull'asse del pistone ad aria del sistema mobile del normale apparecchio di alimentazione e solidale con esso, detto tubo innestandosi per un estremo nella estremità posteriore cava dell'anima del mandrino e attraversando in modo scorrevole a tenuta l'albero ad elica del dispositivo stesso, per sboccare con l'altro estremo in un cilindro cavo posteriore ad esso associato al quale l'acqua di raffreddamento perviene, attraverso una derivazione, da un condotto associato al sistema mobile dell'apparecchio di alimentazioni e scorrevole a cannocchiale su un condotto fisso.

Con questa disposizione si arriva ad alimentare in modo sicuro una maggiore quantità d'acqua di raffreddamento eliminando l'innaffiamento abbondante del mandrino durante il periodo di demandrinazione e di rinculo, ed evitando il raffreddamento brutale della costa esterna del mandrino e di conseguenza la creazione di tensioni nella struttura alla fissurazione del mandrino stesso.

Queste ed altre caratteristiche risulteranno più chiaramente dalla descrizione che segue di una forma preferita di attuazione dell'invenzione, illustrata a titolo esemplificativo e non limitativo nei disegni annessi nei quali:

La figura 1 è una sezione longitudinale del mandrino;

la figura 2 è una sezione trasversale del mandrino secondo la traccia A-A di figura 1, e

la figura 3 è una sezione longitudinale, in

scala ridotta, dell'apparecchio di avanzamento del pellegrino, illustrante la disposizione di adduzione dell'acqua di raffreddamento al mandrino.

In queste figure R è l'apparecchio di alimentazione del treno pellegrino che porta la cassa d'aria Q nella quale il pistone mobile O porta alla sua estremità anteriore il portamandrino C nel quale è fissato, a mezzo di chiavette G, il mandrino M. La rotazione periodica del pistone aria O è effettuata nel modo conosciuto, con l'albero ad elica P. L'acqua di raffreddamento, sotto pressione di 2 a 3 atm., viene addotta tramite il tubo a cannocchiale W, la valvola X, il tubo di collegamento V, al cilindro S fissato alla cassa Q. Un tubo T solidale col pistone ad aria, scorrevole attraverso le guarnizioni U dell'albero ad elica P, fa comunicare il cilindro S col foro interno II dell'anima «m» del mandrino, che convoglia l'acqua parzialmente fino all'estremità del mandrino dalla quale, lungo i canaletti «r» dell'anima «m», raggiunge l'uscita III. Una parte di acqua di raffreddamento attraversa invece i fori radiali «t» dell'anima «m» per riunirsi all'acqua proveniente dalla estremità anteriore del mandrino nei canali «r». La posizione e la sezione di questi fori la cui distribuzione segue preferibilmente un andamento elicoidale sono tali da garantire una temperatura quasi costante dell'acqua di raffreddamento su tutta la lunghezza del mandrino. L'acqua uscente attraverso i canali III è raccolta nell'anello F con uscita in basso e bagna il termostato K collegato a mezzo di cavi L al dispositivo di chiusura o apertura automatica della valvola di ammissione d'acqua X; in questo modo è possibile mantenere una temperatura assoluta costante del mandrino per tutto il tempo di lavoro e durante le fermate.

## RIVENDICAZIONI

1. Mandrino di laminazione a raffreddamento interno, per laminatoi a passo di pellegrino, costituito da un corpo cilindro cavo montato coassialmente su di un'anima cilindrica pure cava in modo da risultare solidale con essa, tra la quale ed il mandrino, oltrechè all'interno dell'anima viene fatta circolare l'acqua di raffreddamento, caratterizzato da ciò che la superficie esterna dell'anima è provvista di una serie numerosa di scanalature parallele formanti con la superficie interna del mandrino altrettanti canali chiusi correnti da un capo all'altro del mandrino e comunicanti con la cavità interna dell'anima attraverso fori radiali dell'anima stessa distribuiti su tutta la sua lunghezza, oltrechè attraverso l'estremità anteriore dell'anima.

2. Mandrino secondo la precedente rivendicazione, nel quale l'estremità posteriore dell'anima si prolunga oltre quella corrispondente del mandrino per innestarsi nel portamandrino formando con esso un canale collettore anulare che riceve l'acqua di raffreddamento scaricata dalle scanalature periferiche dell'anima, e per ricevere nella sua cavità interna l'estremità di un tubo di adduzione dell'acqua, attraversante il pistone di azionamento del mandrino.

3. Macchina secondo le precedenti rivendicazioni, in cui le scanalature della superficie esterna dell'anima sono disposte secondo le generatrici di tale superficie ed il mandrino è laminato sull'anima direttamente nello stesso laminatoio a passo di pellegrino.

4. Mandrino secondo le precedenti rivendicazioni, in cui i canali radiali della anima sono distribuiti elicoidalmente su tutta la sua lunghezza in modo tale e sono così dimensionati da assicurare una temperatura praticamente uniforme su tutta la lunghezza del mandrino.

5. Disposizione di adduzione dell'acqua di raffreddamento al mandrino comportante un tubo disposto sull'asse del pistone ad aria del sistema mobile del normale apparecchio di alimentazione e solidale con esso, detto tubo innestandosi per un estremo nell'estremità posteriore dell'anima del mandrino e attraversando in modo scorrevole ed a tenuta l'albero ad elica del dispositivo stesso per sboccare con l'altro estremo in un cilindro cavo posteriore ad esso associato al quale l'acqua di raffreddamento perviene attraverso una derivazione da un condotto associato al sistema mobile dell'apparecchio di alimentazione e scorrevole a cannocchiale su un condotto fisso.

6. Disposizione secondo la precedente rivendicazione, in cui su detta derivazione è disposta una valvola automatica di regolazione della ammissione dell'acqua di raffreddamento, controllata da un termostato posto sotto l'influenza dell'acqua di raffreddamento uscente dal mandrino.

**Allegati 2 fogli di disegni**

Stampato nel novembre 1955
Stab. Graphicon - RAIMONDI — NAPOLI
Prezzo L. 100

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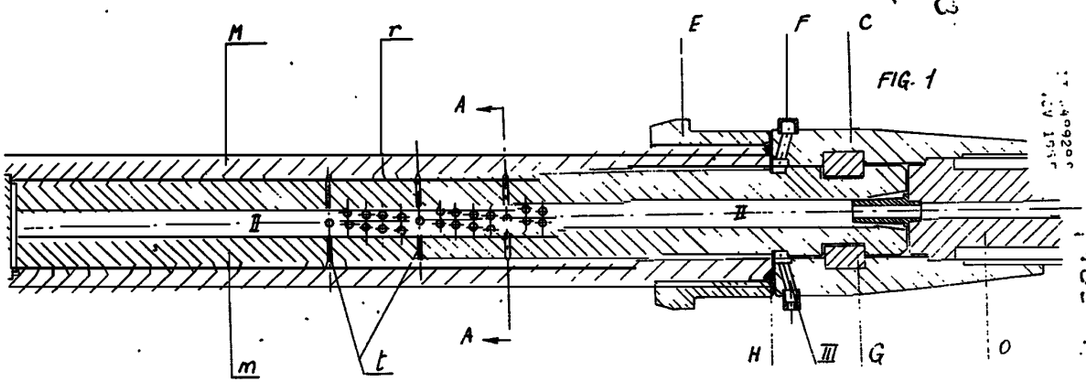


FIG. 1

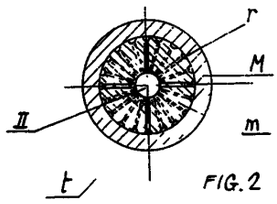


FIG. 2

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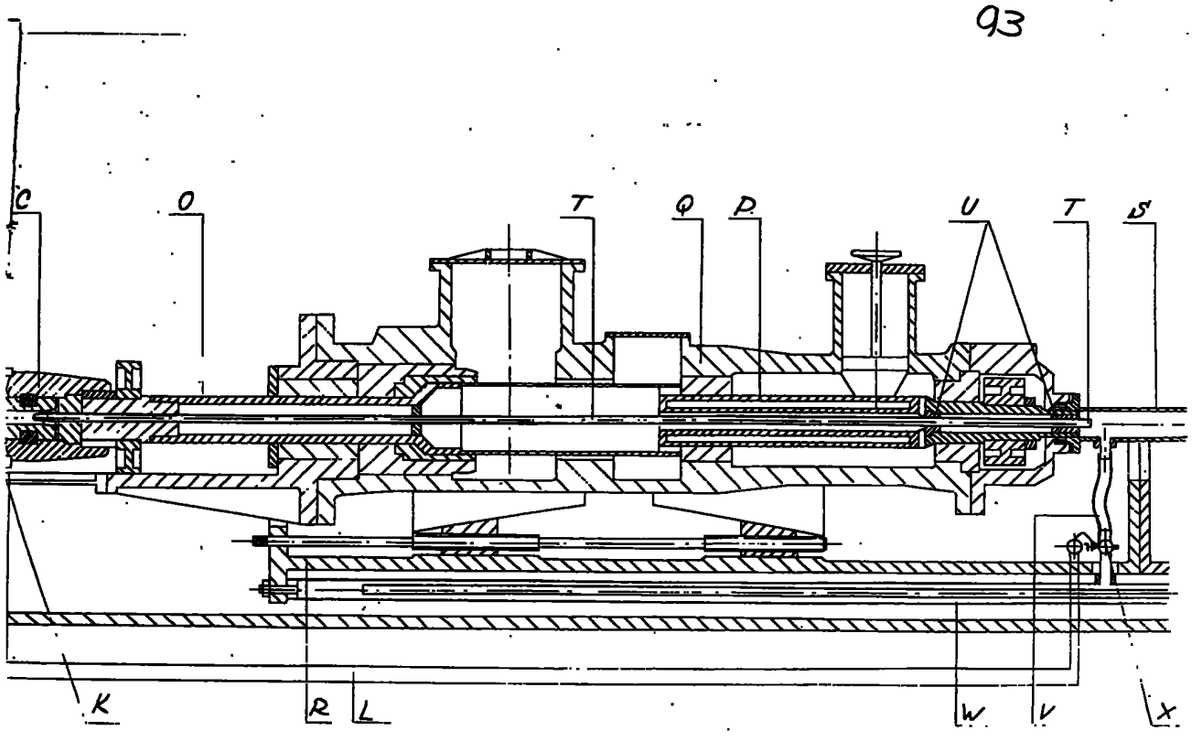


FIG. 3

PTO 03-459

Italy

Document No. 499298

# Perfections in Lamination Mandrils with Internal Cooling And Devices for supplying them with Cooling Fluid

[Perfezionamenti nei mandrini di laminazione a raffreddamento interno e nelle disposizioni di adduzione agli stessi del fluido refrigerante]

Alberto Calmes

UNITED STATES PATENT AND TRADEMARK OFFICE

Washington, D.C. November 2002

Translated by: Schreiber Translation, Inc.

96/95

| | | |
|---|---|---|
| Country | : | Italy |
| Document No. | : | 499298 |
| Document Type | : | Patent |
| Language | : | Italian |
| Inventors | : | Alberto Calmes |
| Applicant | : | [not indicated] |
| IPC | : | [not indicated] |
| Application Date | : | March 24, 1953 |
| Publication Date | : | November 10, 1954 |
| Foreign Language Title | : | Perfezionamenti nei mandrini di laminazione a raffreddamento interno e nelle disposizioni di adduzione agli stessi del fluido refrigerante |
| English Title | : | Perfections in Lamination Mandrils with Internal Cooling and Devices for supplying them with Cooling Fluid |

/1

Mandrils have already been proposed for the lamination [rolling] of pipes with the so-called pilger pitch made for the purpose of supplying cooling water inside and outside of the mandrils themselves.

The object of this invention is to improve the economy of construction and to increase the strength of a mandril of this kind and to provide a mandril made up of a hollow cylindrical body mounted coaxially on a cylindrical core which is also hollow so as to make it integral with it, between which and the mandril as well as the core cooling water is made to circulate characterized in that the external surface of the core is provided with a numerous series of parallel channels that the external surface of the mandril form as many as closed channels running from one head of the mandril to the other and communicating with the internal cavity of the core through radial holes in the core itself distributed over its entire length, as well as the interior end of the core.

Compare to the known types, the thickness of the mandril can thus be greatly reduced without weakening its resistance to crushing so that the cooling effect is considerably increased. One can also achieve a great saving in the matter of mandril material due to the tubular structure of the mandril and the continuous cylindrical inside wall, which is easy to obtain with the same lamination train. As a matter of fact, by making the channels along the generatrices of the core the mandril can be laminated directly

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[1] Numbers in the margin indicate pagination in the foreign text.

on the core in the lamination of the pilger itself. On the other hand, the core becomes a piece that can be recovered for continued use after the mandril has been worn off. This invention also relates to a particular arrangement for the supply of cooling water to the mandril, involving a pipe placed on the axis of the air system of the mobile system of the standard water supply unit and integral with it, said pipe being engaged by one end in the posterior hollow extremity of the core of the mandril and the smoothly and tightly passing through the screw shaft of the device itself, in order to end that the other extremity in the hollow posterior cylinder that is associated with it and which cooling water is piped, through a branch from a pipeline associated with the mobile system of the supply unit operating smoothly in a telescoping manner on a fixed pipe.

With the help of this arrangement one can securely supply a larger volume of cooling water, thus eliminating the abundant sprinkling of the mandril during the period of mandril removal and recoil and thus preventing the abrupt cooling of the outer rib of the mandril consequently leading the creation of stressing in the structure which can cause the mandril itself to crack.

These and other features will emerge more clearly from the following description of a preferred embodiment of the invention, illustrated by way of example and without any restrictions referring to the attached drawings.

Figure 1 is a longitudinal profile of the mandril.

Figure 2 is a cross-section of the mandril along A-A in figure

1.

Figure 3 is a longitudinal profile on a reduced scale of the unit for the advancement of the pilger illustrating the arrangement for cooling water supply to the mandril.

/2

In these figures R is the supply unit for the pilger train that carries air chamber Q in which mobile piston O at its anterior end carries the mandril carrier C in which is fixed by means of keys G, the mandril M. The periodic rotation of air piston O is accomplished in a known manner with screw shaft P. The cooling water, on a pressure of between 2 and 3 atm abs is provided through the telescoping pipe W, valve X, connecting pipe V, cylinder S attached to chamber Q. A pipe T that is integral with the air piston, smoothly moving through the packing of screw shaft B links cylinder S to the internal hole II of core 'm' of the mandril which moves the water partially up to the end of the mandril from which along ducts 'r' of the core 'm' it reaches the outlet III. A portion of the cooling water instead go through the radial holes 't' of the 'm' in order to link up with the water coming from the anterior end of the mandril in ducts 'r'. The position and the section of these holes - whose distribution preferably follows a helicoidal pattern - as such as guarantees an almost constant temperature in the cooling water over the entire length of the mandril. The water that comes out through ducts III is collected in ring F which has an outlet below and which washes around the thermostat K that is linked by means of cables L to the device that

takes care of the automatic closing or opening of the water inlet valve X. In this way, one can maintain an absolutely constant temperature in the mandril for the entire operating time and during shut downs.

CLAIMS

1. The lamination mandril with internal cooling, for rolling mills with pilger pitch consisting of a hollow cylindrical body mounted coaxially on a cylindrical core that is also hollow so as to be integral with it between the latter and the mandril also inside the core, the cooling water is made to circulate, characterized in that the surface of the core is provided with the numerous series of parallel groves which with the internal surface of the mandril, form as many closed ducts running from one head of the mandible to the other and communicating with the internal cavity of the core through radial holes in the core itself distributed over its entire length as well as passing through the anterior end of the core.

2. Mandril according to the preceding claim where the posterior end of the core is prolonged beyond the end corresponding to the mandril in order to engage the mandril carrier forming with it a ring-shaped collector duct that receives the cooling water discharged by the peripheral grooves of the core, and in its internal cavity receiving the end of the water supply pipe passing through the mandril activated piston.

3. Mandril according to the preceding claims where the grooves of the outer surface of the core are arranged along the

generatrices of said surface and where the mandril is rolled on the core directly in the rolling mill itself with the pilger pitch.

4. Mandril according to the above claims where the radial ducts of the core are distributed in a helicoidal pattern over its entire length in such a way and are so dimensioned as to ensure a practically uniform temperature over the entire length of the mandril.

5. Device for supplying cooling water to the mandril comprising a pipe arranged on the axis of the air piston of the mobile system of the standard water supply unit and integral with it said pipe engaging on one end of the posterior end of the core of the mandril and smoothly passing tightly through the screw shaft of the device itself in order to emerge with the other end in a posterior hollow cylinder associated with it to which cooling water is supplied through a branch by a pipe associated with mobile system of the supply unit running smoothly in a telescoping fashion on a fixed duct.

6. Arrangement according to the preceding claim where on said branch there is arranged an automatic valve for regulating the intake of cooling water, controlled by a thermostat that is under the influence of the cooling water coming out of the mandril.

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FIG. 1

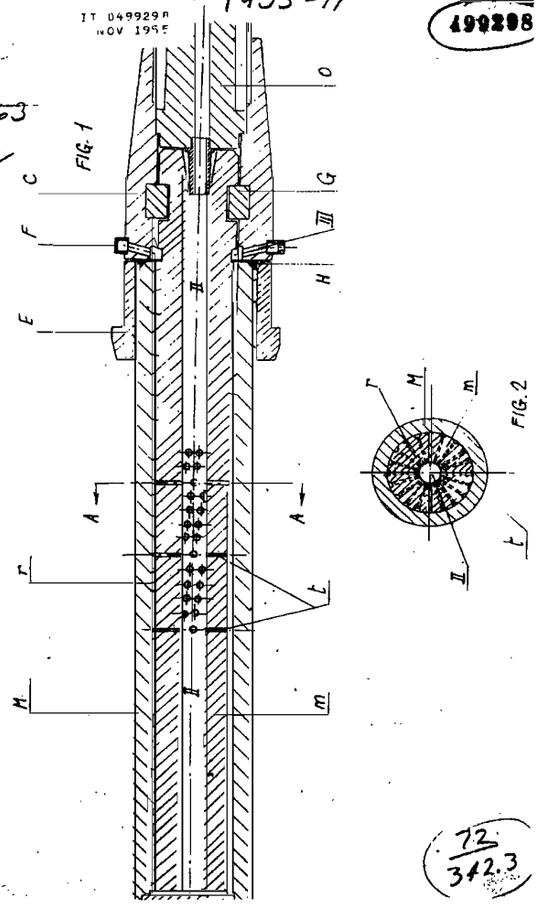





FIG. 2

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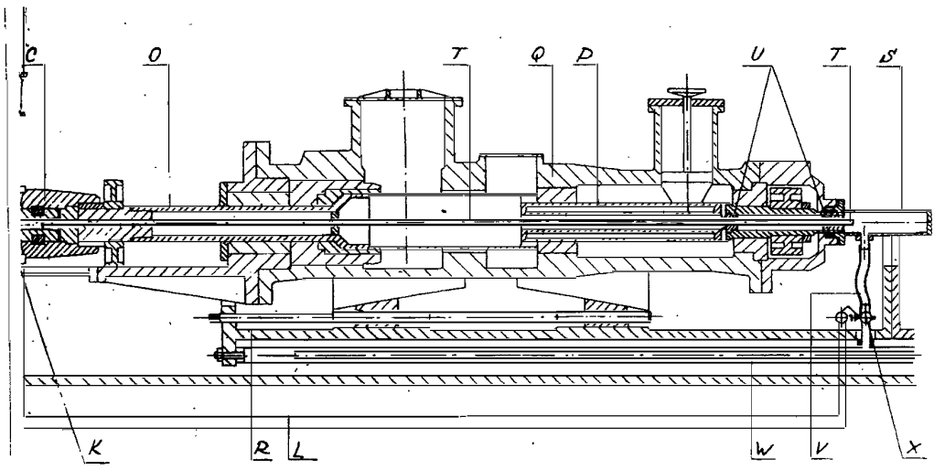


FIG 3

1/09/03

# PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:
MITCHELL D. BITTMAN
SEQUA CORPORATION
3 UNIVERSITY PLAZA
HACKENSACK, NJ 07601

# PCT

## NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

| Date of Mailing (day/month/year) | 15 AUG 2003 |
|---|---|

| Applicant's or agent's file reference | IMPORTANT NOTIFICATION |
|---|---|
| RM-107(PCT) | |

| International application No. | International filing date (day/month/year) | Priority date (day/month/year) |
|---|---|---|
| PCT/US02/34895 | 31 October 2002 (31.10.2002) | 02 November 2001 (02.11.2001) |

Applicant

SEQUA CAN MACHINERY, INC.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices)(Article 39(1))(see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

| Name and mailing address of the IPEA/US | Authorized officer |
|---|---|
| Mail Stop PCT, Attn: IPEA/US<br>Commissioner for Patents<br>P.O. Box 1450<br>Alexandria, Virginia 22313-1450 | Allen Ostrager<br>Telephone No. 703-308-3136 |
| Facsimile No. (703)305-3230 | Sheila H. Veney<br>Paralegal Specialist<br>Tech. Center 3700 |

Form PCT/IPEA/416 (July 1992)

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

**(PCT Article 36 and Rule 70)**

| Applicant's or agent's file reference<br>RM-107(PCT) | FOR FURTHER ACTION | See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) |
|---|---|---|
| International application No.<br>PCT/US02/34895 | International filing date *(day/month/year)*<br>31 October 2002 (31.10.2002) | Priority date *(day/month/year)*<br>02 November 2001 (02.11.2001) |
| International Patent Classification (IPC) or national classification and IPC<br>IPC(7): B21D 37/16 and US Cl.: 72/342.3 | | |
| Applicant<br>SEQUA CAN MACHINERY, INC. | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 0 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of report with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

| Date of submission of the demand | Date of completion of this report |
|---|---|
| 19 May 2003 (19.05.2003) | 30 July 2003 (30.07.2003) |
| Name and mailing address of the IPEA/US<br>Mail Stop PCT, Attn: IPEA/US<br>Commissioner for Patents<br>P.O. Box 1450<br>Alexandria, Virginia 22313-1450<br>Facsimile No. (703)305-3230 | Authorized officer<br>Allen Ostrager<br>Telephone No. 703-308-3136<br>Sheila H. Veney<br>Paralegal Specialist<br>Tech. Center 3700 |

Form PCT/IPEA/409 (cover sheet)(July 1998)

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US02/34895

## I. Basis of the report

1. With regard to the elements of the international application:*

☒ the international application as originally filed.

☒ the description:
pages 1-6 as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

☒ the claims:
pages 7 and 8, as originally filed
pages NONE, as amended (together with any statement) under Article 19
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

☒ the drawings:
pages 1-4, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

☐ the sequence listing part of the description:
pages NONE, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination(under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in printed form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☒ The amendments have resulted in the cancellation of:

☒ the description, pages NONE

☒ the claims, Nos. NONE

☒ the drawings, sheets/~~fig~~ NONE

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

** Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

*** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.*

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US02/34895

**V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. STATEMENT

| | | | |
|---|---|---|---|
| Novelty (N) | Claims | 1-9 | YES |
| | Claims | NONE | NO |
| Inventive Step (IS) | Claims | 1-9 | YES |
| | Claims | NONE | NO |
| Industrial Applicability (IA) | Claims | 1-9 | YES |
| | Claims | NONE | NO |

2. CITATIONS AND EXPLANATIONS

Claims 1-9 meet the criteria under PCT Article 33(2) because the prior art does not anticipate a punch assembly having a an annular array of circumferentially spaced inlet tubes connected to radial inlet ports in conjuntion with a separate annular array of circumferentially spaced outlet tubes, connected to separate radial outlet ports.

Claims 1-9 meeting the criteria set out in PCT Article 33(3) because the prior art does not teach or fairly suggest a punch including a cooling system with both an annular array of circumferentially spaced inlet tubes connected to radial inlet ports and a separate annular array of circumferentially spaced outlet tubes, connected to separate radial outlet ports.

The closest prior art is IT 499298, which disicloses an annular array of outlet tubes connected to radial ports. The reference discloses that the raidal ports are used to connect the sigle inlset tube to the annualr array of outlet tubes but does not disclose an annular array of inlet tubes.

Similarly, Shah (3,577,753) discloses a punch assembly for producing container bodies including comprising: a single inlet tube (36) disposed a the circumference of the punch; an annular array of circumferentially spaced outlet tubes (39); a single radial inlet port (34); a single radial outlet port (42). Shah lacks a "plurality" of inlet ports, outlet ports and inlet tubes. Further, Shah does not disicose an annular array of inlet tubes.

Claims 1-9 meet the criteria set out in PCT Article 33(4), because the invention can be made and used in industry.

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# PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
MITCHELL D. BITTMAN
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3 UNIVERSITY PLAZA
HACKENSACK, NJ 07601

# PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

| | |
|---|---|
| | Date of Mailing (*day/month/year*) 23 DEC 2002 |
| Applicant's or agent's file reference RM-107(PCT) | FOR FURTHER ACTION See paragraphs 1 and 4 below |
| International application No. PCT/US02/34895 | International filing date (*day/month/year*) 31 October 2002 (31.10.2002) |
| Applicant SEQUA CAN MACHINERY, INC. | |

1. ☒ The applicant is hereby notified that the international search report has been established and is transmitted herewith.

   **Filing of amendments and statement under Article 19:**
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   **When?** The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   **Where?** Directly to the International Bureau of WIPO, 34, chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 740.14.35

   For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   Shortly after 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90 *bis*.1 and 90 *bis*.3, respectively, before the completion of the technical preparations for international publication.

   Within 19 months from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later); otherwise the applicant must, within 20 months from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

   In respect of other designated Offices, the time limit of 30 months (or later) will apply even if no demand is filed within 19 months.

   See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

| | |
|---|---|
| Name and mailing address of the ISA/US<br>Commissioner for Patents<br>Box PCT<br>Washington, D.C. 20231<br>Facsimile No. (703)305-3230 | Authorized officer<br>Allen Marcus<br>Allen Ostrager Special Program Examiner<br>Group 3700<br>Telephone No. 703-308-3136 |

Form PCT/ISA/220 (April 2002) (*See notes on accompanying sheet*)

100/108

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

| | | |
|---|---|---|
| Applicant's or agent's file reference RM-107(PCT) | FOR FURTHER ACTION | see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below. |
| International application No. PCT/US02/34895 | International filing date (*day/month/year*) 31 October 2002 (31.10.2002) | (Earliest) Priority Date (*day/month/year*) 02 November 2001 (02.11.2001) |
| Applicant SEQUA CAN MACHINERY, INC. | | |

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the Report**
   a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
   ☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
   b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing:
   ☐ contained in the international application in written form.
   ☐ filed together with the international application in computer readable form.
   ☐ furnished subsequently to this Authority in written form.
   ☐ furnished subsequently to this Authority in computer readable form.
   ☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   ☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.
2. ☐ Certain claims were found unsearchable (See Box I).
3. ☐ Unity of invention is lacking (See Box II).
4. With regard to the title,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,
   ☐ the text is approved as submitted by the applicant.
   ☒ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No. 1
   ☒ as suggested by the applicant. ☐ None of the figures
   ☐ because the applicant failed to suggest a figure.
   ☐ because this figure better characterizes the invention.

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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/34895

**Box III TEXT OF THE ABSTRACT (Continuation of Item 5 of the first sheet)**

**NEW ABSTRACT**

An internally cooled punch (6) disposed on the end of a ram (4) in a can forming machine. Internal fluid cooling means in the ram (4) avoids the need for externally applied cooling fluids. A plurality of parallel fluid transfer tubes (8,10) is arranged annularly with the ram (4). Cooling medium flows through inlet tubes (8) to radial inlet ports (16) which supply the cooling medium to the inner surface of the punch (6) where the medium flows rearwardly through a channel (18) at the inner surface of the punch (6) to radial outlet ports (20) leading to outlet tubes (10) through the ram (4). Discharged cooling media flows back along the ram and out through a manifold (12). The transfer tubes (8,10) are arranged symmetrically in an alternating array circumferentially around the ram (4) to reduce radial temperature gradients within the ram (4). A central port (24) allows air flow through the ram (4) to aid in stripping the formed container from the punch (6).

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# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US02/34895

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : B21D 37/16
US CL : 72/342.3
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 72/342.3

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | US 3,577,753 A (SHAH) 04 May 1971 (04.05.1971), whole document. | 1-8 |
| Y | US 5,678,442 A (OHBA et al.) 21 October 1997 (21.10.1997), Fig. 8 and column 2 lines 22-41. | 1-8 |
| Y | US 6,216,511 A (OHNISHI et al.) 17 April 2001 (17.04.2001), column 6, lines 28-30. | 1-8 |
| A | IT 499,298 A (CALMES) 10 November 1954 (10.11.1954), whole document. | 1-9 |

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
09 December 2002 (09.12.2002)

Date of mailing of the international search report
23 DEC 2002

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231
Facsimile No. (703)305-3230

Authorized officer
Allen Ostrager
Stephen Marcus
Special Program Examiner
Group 3700

Telephone No. 703-308-3136

Form PCT/ISA/210 (second sheet) (July 1998)

*The demand must be filed directly with the competent International Preliminary Examining Authority or, if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below*

IPEA/ US

# PCT

**CHAPTER II**

## DEMAND

under Article 31 of the Patent Cooperation Treaty:
The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

| For International Preliminary Examining Authority use only | |
|---|---|
| Identification of IPEA | Date of receipt of DEMAND |

| Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION | | Applicant's or agent's file reference: RM-107 (PCT) |
|---|---|---|
| International application No.: PCT/US02/34895 | International filing date (day/month/year): 31 OCTOBER 2002 (31.10.02) | (Earliest) Priority date (day/month/year): 02 NOVEMBER 2001 (02.11.01) |
| Title of invention: INTERNALLY COOLED PUNCH | | |

**Box No. II APPLICANT(S)**

| Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)* | Telephone No.: 201-933-1200<br>Facsimile No.: 201-438-7801<br>Teleprinter No.:<br>Applicant's registration No. with the Office: |
|---|---|
| SEQUA CAN MACHINERY, INC.<br>401 CENTRAL AVENUE<br>EAST RUTHERFORD, NJ 07073<br>US | |

| State *(that is, country)* of nationality: | State *(that is, country)* of residence: |
|---|---|
| US | US |

| Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)* | |
|---|---|
| | |
| State *(that is, country)* of nationality: | State *(that is, country)* of residence: |

| Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)* | |
|---|---|
| | |
| State *(that is, country)* of nationality: | State *(that is, country)* of residence: |

☐ Further applicants are indicated on a continuation sheet.

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+13

Sheet No. 2

International application No.
PCT/US02/34895

**Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE**

The following person is [X] agent [ ] common representative

and [X] has been appointed earlier and represents the applicant(s) also for international preliminary examination.

[ ] is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.

[ ] is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

BITTMAN, MITCHELL D.
SEQUA CORPORATION
THREE UNIVERSITY PLAZA
HACKENSACK, NJ 07601
US

Telephone No.
201-343-1122

Facsimile No.
201-488-2014

Teleprinter No.

Agent's registration No. with the Office
27517

[ ] Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

**Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION**

Statement concerning amendments:*

1. The applicant wishes the international preliminary examination to start on the basis of:

[X] the international application as originally filed

the description [X] as originally filed
[ ] as amended under Article 34

the claims [X] as originally filed
[ ] as amended under Article 19 (together with any accompanying statement)
[ ] as amended under Article 34

the drawings [X] as originally filed
[ ] as amended under Article 34

2. [ ] The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.

3. [ ] The applicant wishes the start of the international preliminary examination to be postponed until the expiration of 20 months from the priority date unless the International Preliminary Examining Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)*

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: English

[X] which is the language in which the international application was filed.

[ ] which is the language of a translation furnished for the purposes of international search.

[ ] which is the language of publication of the international application.

[ ] which is the language of the translation (to be) furnished for the purposes of international preliminary examination.

**Box No. V ELECTION OF STATES**

The applicant hereby elects all eligible States *(that is, all States which have been designated and which are bound by Chapter II of the PCT)*

excluding the following States which the applicant wishes not to elect:

13/44

Sheet No. 3

International application No.
PCT/US02/34895

**Box No. VI CHECK LIST**

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:

| | | | For International Preliminary Examining Authority use only: received | not received |
|---|---|---|---|---|
| 1. translation of international application | : | sheets | ☐ | ☐ |
| 2. amendments under Article 34 | : | sheets | ☐ | ☐ |
| 3. copy (or, where required, translation) of amendments under Article 19 | : | sheets | ☐ | ☐ |
| 4. copy (or, where required, translation) of statement under Article 19 | : | sheets | ☐ | ☐ |
| 5. letter | : | sheets | ☐ | ☐ |
| 6. other *(specify)* | : | sheets | ☐ | ☐ |

The demand is also accompanied by the item(s) marked below:

1. ☒ fee calculation sheet
2. ☐ original separate power of attorney
3. ☐ original general power of attorney
4. ☐ copy of general power of attorney; reference number, if any:
5. ☐ statement explaining lack of signature
6. ☐ sequence listings in computer readable form
7. ☐ tables in computer readable form related to sequence listings
8. ☐ other *(specify)*:

**Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE**

*Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).*

SEQUA CAN MACHINERY, INC.

BY Mitchell D Bittman

Mitchell D. Bittman, Assistant Secretary

DATE 19/05/03

**For International Preliminary Examining Authority use only**

1. Date of actual receipt of DEMAND:

2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply. ☐ The applicant has been informed accordingly.

4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.

5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

**For International Bureau use only**

Demand received from IPEA on:

HS
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CHAPTER II

# PCT

## FEE CALCULATION SHEET

**Annex to the Demand**

| | |
|---|---|
| International application No. PCT/US02/34895 | For International Preliminary Examining Authority use only |
| Applicant's or agent's file reference RM-107 (PCT) | Date stamp of the IPEA |

Applicant

SEQUA CAN MACHINERY, INC.

**CALCULATION OF PRESCRIBED FEES**

| | | |
|---|---|---|
| 1. Preliminary examination fee ..... | 490.00 P | |
| 2. Handling fee *(Applicants from certain States are entitled to a reduction of 75% of the handling fee. Where the applicant is (or all applicants are) so entitled, the amount to be entered at H is 25% of the handling fee.)* ..... | 146.00 H | |
| 3. Total of prescribed fees Add the amounts entered at P and H and enter total in the TOTAL box ..... | 636.00 TOTAL | |

**MODE OF PAYMENT**

- ☐ authorization to charge deposit account with the IPEA (see below)
- ☒ cheque
- ☐ postal money order
- ☐ bank draft
- ☐ cash
- ☐ revenue stamps
- ☐ coupons
- ☐ other *(specify)*:

**AUTHORIZATION TO CHARGE (OR CREDIT) DEPOSIT ACCOUNT**
*(This mode of payment may not be available at all IPEAs)*

IPEA/ US

- ☐ Authorization to charge the total fees indicated above.
- ☒ *(This check-box may be marked only if the conditions for deposit accounts of the IPEA so permit)* Authorization to charge any deficiency or credit any overpayment in the total fees indicated above.

Deposit Account No.: 19-4970

Date: Mitchell D Bittman

Name: Mitchell D. Bittman

Signature: 19/05/03

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# PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

# PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:

BITTMAN, Mitchell, D.
Sequa Corporation
3 University Plaza
Hackensack, NJ 07601
ETATS-UNIS D'AMERIQUE

| Date of mailing (day/month/year) | |
|---|---|
| 15 May 2003 (15.05.03) | |
| Applicant's or agent's file reference | IMPORTANT NOTICE |
| RM-107(PCT) | |

| International application No. | International filing date (day/month/year) | Priority date (day/month/year) |
|---|---|---|
| PCT/US02/34895 | 31 October 2002 (31.10.02) | 02 November 2001 (02.11.01) |

Applicant

SEQUA CAN MACHINERY INC.

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this notice:

   KP, KR

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

   AE, AG, AL, AM, AP, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EA, EC, EE, EP, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OA, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW

   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-*bis*)).

3. Enclosed with this notice is a copy of the international application as published by the International Bureau on 15 May 2003 (15.05.03) under No. 03/039783

4. **TIME LIMITS for filing a demand for international preliminary examination and for entry into the national phase**

   The applicable time limit for entering the national phase will, subject to what is said in the following paragraph, be 30 MONTHS from the priority date, not only in respect of any elected Office if a demand for international preliminary examination is filed before the expiration of 19 months from the priority date, but also in respect of any designated Office, in the absence of filing of such demand, where Article 22(1) as modified with effect from 1 April 2002 applies in respect of that designated Office. For further details, see *PCT Gazette* No. 44/2001 of 1 November 2001, pages 19926, 19932 and 19934, as well as the *PCT Newsletter*, October and November 2001 and February 2002 issues.

   In practice, time limits other than the 30-month time limit will continue to apply, for various periods of time, in respect of certain designated or elected Offices. For regular updates on the applicable time limits (20, 21, 30 or 31 months, or other time limit), Office by Office, refer to the *PCT Gazette*, the *PCT Newsletter* and the *PCT Applicant's Guide*, Volume II, National Chapters, all available from WIPO's Internet site, at http://www.wipo.int/pct/en/index.html.

   For filing a demand for international preliminary examination, see the *PCT Applicant's Guide*, Volume I/A, Chapter IX. Only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination (at present, all PCT Contracting States are bound by Chapter II).

   It is the applicant's sole responsibility to monitor all these time limits.

| The International Bureau of WIPO<br>34, chemin des Colombettes<br>1211 Geneva 20, Switzerland | Authorized officer<br>Judith Zahra |
|---|---|
| Facsimile No.(41-22) 740.14.35 | Telephone No.(41-22) 338.91.11 |

Form PCT/IB/308 (April 2002)

# PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

## PCT

**NOTIFICATION CONCERNING SUBMISSION OR TRANSMITTAL OF PRIORITY DOCUMENT**

(PCT Administrative Instructions, Section 411)

To:

BITTMAN, Mitchell, D.
Sequa Corporation
3 University Plaza
Hackensack, NJ 07601
United States of America

| | |
|---|---|
| Date of mailing (day/month/year)<br>24 January 2003 (24.01.03) | |
| Applicant's or agent's file reference<br>RM-107(PCT) | IMPORTANT NOTIFICATION |
| International application No.<br>PCT/US02/34895 | International filing date (day/month/year)<br>31 October 2002 (31.10.02) |
| International publication date (day/month/year)<br>Not yet published | Priority date (day/month/year)<br>02 November 2001 (02.11.01) |
| Applicant<br>SEQUA CAN MACHINERY INC. | |

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
3. An asterisk(*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
4. The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

| Priority date | Priority application No. | Country or regional Office or PCT receiving Office | Date of receipt of priority document |
|---|---|---|---|
| 02 Nove 2001 (02.11.01) | 10/003,641 | US | 28 Nove 2002 (28.11.02) |

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 338-8999

Authorized officer

S. Mandallaz

Telephone No. (41-22) 338 9881

# PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

## PCT

**INFORMATION CONCERNING ELECTED OFFICES NOTIFIED OF THEIR ELECTION**

(PCT Rule 61.3)

To:

BITTMAN, Mitchell, D.
Sequa Corporation
3 University Plaza
Hackensack, NJ 07601
United States of America

| | |
|---|---|
| Date of mailing (day/month/year)<br>18 June 2003 (18.06.03) | |
| Applicant's or agent's file reference<br>RM-107(PCT) | IMPORTANT INFORMATION |

| International application No. | International filing date (day/month/year) | Priority date (day/month/year) |
|---|---|---|
| PCT/US02/34895 | 31 October 2002 (31.10.02) | 02 November 2001 (02.11.01) |

Applicant
SEQUA CAN MACHINERY INC.

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

   EP :AT,BE,BG,CH,CY,CZ,DE,DK,EE,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE,SK,TR
   National :AU,BG,CA,CN,DE,GB,IL,JP,KP,KR,MN,NO,PL,RO,RU,SK

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

   AP :GH,GM,KE,LS,MW,MZ,SD,SL,SZ,TZ,UG,ZM,ZW
   EA :AM,AZ,BY,KG,KZ,MD,RU,TJ,TM
   OA :BF,BJ,CF,CG,CI,CM,GA,GN,GQ,GW,ML,MR,NE,SN,TD,TG
   National :AE,AG,AL,AM,AT,AZ,BA,BB,BR,BY,BZ,CH,CO,CR,CU,CZ,DK,DM,DZ,EC,EE,
   ES,FI,GD,GE,GH,GM,HR,HU,ID,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MA,MD,MG,
   MK,MW,MX,MZ,NZ,OM,PH,PT,SD,SE,SG,SI,SL,TJ,TM,TN,TR,TT,TZ,UA,UG,UZ,VN,YU,
   ZA,ZM,ZW

3. The applicant is reminded that he must enter the "national phase" before the expiration of 30 months from the priority date before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing , if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

   Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

   The entry into the European regional phase is postponed until 31 months from the priority date for all States designated for the purposes of obtaining a European patent.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 338-70-90

Authorized officer:
David MALEK

Telephone No. (41-22) 338 8886

# PCT

## REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* RM-107(PCT)

**Box No. I TITLE OF INVENTION**
Internally Cooled Punch

**Box No. II APPLICANT** ☐ This person is also inventor

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

Sequa Can Machinery, Inc.
401 Central Avenue
East Rutherford, NJ 07073
US

Telephone No.
(201) 933-1200

Facsimile No.
(201) 438-7801

Teleprinter No.

Applicant's registration No. with the Office

State *(that is, country)* of nationality:
US

State *(that is, country)* of residence:
US

This person is applicant for the purposes of: ☒ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

**Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)**

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

BLUE, RODNEY
17421 Hillgate Lane
Huntington Beach, CA 92649

This person is:
☐ applicant only
☐ applicant and inventor
☒ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality:
US

State *(that is, country)* of residence:
US

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

**Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE**

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

BITTMAN, MITCHELL D.
SEQUA CORPORATION
3 UNIVERSITY PLAZA
HACKENSACK, NJ 07601
US

Telephone No.
(201) 343-1122

Facsimile No.
(201) 488-2014

Teleprinter No.

Agent's registration No. with the Office
27517

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

**Box No. V DESIGNATION OF STATES** *Mark the applicable check-boxes below; at least one must be marked.*

The following designations are hereby made under Rule 4.9(a):

**Regional Patent**

- ☒ AP **ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, MZ Mozambique, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZM Zambia, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....
- ☒ EA **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP **European Patent:** AT Austria, BE Belgium, BG Bulgaria, CH & LI Switzerland and Liechtenstein, CY Cyprus, CZ Czech Republic, DE Germany, DK Denmark, EE Estonia, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, SK Slovakia, TR Turkey, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GQ Equatorial Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

**National Patent** *(if other kind of protection or treatment desired, specify on dotted line)*:

| | | |
|---|---|---|
| ☒ AE United Arab Emirates ..... | ☒ GM Gambia | ☒ NZ New Zealand ..... |
| ☒ AG Antigua and Barbuda | ☒ HR Croatia ..... | ☒ OM Oman |
| ☒ AL Albania ..... | ☒ HU Hungary ..... | ☒ PH Philippines ..... |
| ☒ AM Armenia ..... | ☒ ID Indonesia | ☒ PL Poland ..... |
| ☒ AT Austria ..... | ☒ IL Israel ..... | ☒ PT Portugal ..... |
| ☒ AU Australia ..... | ☒ IN India ..... | ☒ RO Romania |
| ☒ AZ Azerbaijan ..... | ☒ IS Iceland | ☒ RU Russian Federation ..... |
| ☒ BA Bosnia and Herzegovina ..... | ☒ JP Japan ..... | ..... |
| ☒ BB Barbados | ☒ KE Kenya ..... | ☒ SD Sudan |
| ☒ BG Bulgaria ..... | ☒ KG Kyrgyzstan ..... | ☒ SE Sweden |
| ☒ BR Brazil ..... | ☒ KP Democratic People's Republic of Korea ..... | ☒ SG Singapore |
| ☒ BY Belarus ..... | ☒ KR Republic of Korea ..... | ☒ SI Slovenia ..... ..... |
| ☒ BZ Belize ..... | ☒ KZ Kazakhstan ..... | ☒ SK Slovakia ..... ..... |
| ☒ CA Canada | ☒ LC Saint Lucia | ☒ SL Sierra Leone ..... |
| ☒ CH & LI Switzerland and Liechtenstein | ☒ LK Sri Lanka | ☒ TJ Tajikistan ..... |
| ☒ CN China ..... | ☒ LR Liberia | ☒ TM Turkmenistan ..... ..... |
| ☒ CO Colombia | ☒ LS Lesotho ..... | ☒ TN Tunisia |
| ☒ CR Costa Rica ..... | ☒ LT Lithuania | ☒ TR Turkey ..... |
| ☒ CU Cuba ..... | ☒ LU Luxembourg | ☒ TT Trinidad and Tobago ..... |
| ☒ CZ Czech Republic ..... | ☒ LV Latvia | ..... |
| ☒ DE Germany ..... | ☒ MA Morocco ..... | ☒ TZ United Republic of Tanzania |
| ☒ DK Denmark ..... | ☒ MD Republic of Moldova ..... | ☒ UA Ukraine ..... ..... |
| ☒ DM Dominica | ..... | ☒ UG Uganda ..... |
| ☒ DZ Algeria ..... | ☒ MG Madagascar ..... | ☐ US United States of America ..... |
| ☒ EC Ecuador ..... | ☒ MK The former Yugoslav Republic of Macedonia ..... | ..... |
| ☒ EE Estonia ..... | ☒ MN Mongolia | ☒ UZ Uzbekistan ..... |
| ☒ ES Spain ..... | ☒ MW Malawi ..... | ☒ VN Viet Nam ..... ..... |
| ☒ FI Finland ..... | ☒ MX Mexico ..... | ☒ YU Yugoslavia ..... ..... |
| ☒ GB United Kingdom | ☒ MZ Mozambique ..... | ☒ ZA South Africa .. ..... |
| ☒ GD Grenada | ☒ NO Norway | ☒ ZM Zambia |
| ☒ GE Georgia ..... | | ☒ ZW Zimbabwe ... . ..... |
| ☒ GH Ghana ..... | | |

Check-boxes below reserved for designating States which have become party to the PCT after issuance of this sheet

| | | |
|---|---|---|
| ☐ ..... | ☐ ..... | ☐ ..... |
| ☐ ..... | ☐ ..... | ☐ ..... .... ..... |

**Precautionary Designation Statement:** In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)*

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**Box No. VI PRIORITY CLAIM**

The priority of the following earlier application(s) is hereby claimed:

| Filing date of earlier application *(day/month/year)* | Number of earlier application | Where earlier application is: | | |
|---|---|---|---|---|
| | | national application: country or Member of WTO | regional application:* regional Office | international application: receiving Office |
| item (1) 02 November 2001 (02.11.01) | 10/003,641 | US | | |
| item (2) | | | | |
| item (3) | | | | |
| item (4) | | | | |
| item (5) | | | | |

☐ Further priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of this international application is the receiving Office)* identified above as:

☐ all items ☒ item (1) ☐ item (2) ☐ item (3) ☐ item (4) ☐ item (5) ☐ other, see Supplemental Box

* *Where the earlier application is an ARIPO application, indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed (Rule 4.10(b)(ii)):* ....

**Box No. VII INTERNATIONAL SEARCHING AUTHORITY**

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used)*:

ISA / US

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority)*:

| Date *(day/month/year)* | Number | Country *(or regional Office)* |
|---|---|---|
| 02 November 2001 (02.11.01) | 10/003,641 | US |

**Box No. VIII DECLARATIONS**

| The following declarations are contained in Boxes Nos. VIII (i) to (v) *(mark the applicable check-boxes below and indicate in the right column the number of each type of declaration)*: | | Number of declarations |
|---|---|---|
| ☐ Box No. VIII (i) | Declaration as to the identity of the inventor | : |
| ☐ Box No. VIII (ii) | Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent | : |
| ☐ Box No. VIII (iii) | Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application | : |
| ☐ Box No. VIII (iv) | Declaration of inventorship (only for the purposes of the designation of the United States of America) | : |
| ☐ Box No. VIII (v) | Declaration as to non-prejudicial disclosures or exceptions to lack of novelty | : |

**Box No. IX CHECK LIST; LANGUAGE OF FILING**

This international application contains:

(a) the following number of sheets in paper form:

| | | |
|---|---|---|
| request (including declaration sheets) | : | 3 |
| description (excluding sequence listing part) | : | 6 |
| claims | : | 2 |
| abstract | : | 1 |
| drawings | : | 4 |
| Sub-total number of sheets | : | 16 |
| sequence listing part of description *(actual number of sheets if filed in paper form, whether or not also filed in computer readable form; see (b) below)* | : | |
| Total number of sheets | : | 16 |

(b) sequence listing part of description filed in computer readable form

(i) ☐ only (under Section 801(a)(i))

(ii) ☐ in addition to being filed in paper form (under Section 801(a)(ii))

Type and number of carriers (diskette, CD-ROM, CD-R or other) on which the sequence listing part is contained *(additional copies to be indicated under item 9(ii), in right column)*: .....

This international application is accompanied by the following item(s) *(mark the applicable check-boxes below and indicate in right column the number of each item)*.

| | Number of items |
|---|---|
| 1. ■ fee calculation sheet | 1 |
| 2. ☐ original separate power of attorney | |
| 3. ☐ original general power of attorney | |
| 4. ☐ copy of general power of attorney; reference number, if any: ..... | |
| 5. ☐ statement explaining lack of signature | |
| 6. ☐ priority document(s) identified in Box No. VI as item(s): ..... | |
| 7. ☐ translation of international application into *(language)*: ..... | |
| 8. ☐ separate indications concerning deposited microorganism or other biological material | |
| 9. ☐ sequence listing in computer readable form (indicate also type and number of carriers (diskette, CD-ROM, CD-R or other)) | |
| (i) ☐ copy submitted for the purposes of international search under Rule 13*ter* only (and not as part of the international application) | |
| (ii) ☐ *(only where check-box (b)(i) or (b)(ii) is marked in left column)* additional copies including, where applicable, the copy for the purposes of international search under Rule 13*ter* | |
| (iii) ☐ together with relevant statement as to the identity of the copy or copies with the sequence listing part mentioned in left column | |
| 10. ☐ other *(specify)*: ..... | |

Figure of the drawings which should accompany the abstract: Fig. 1

Language of filing of the international application: English

**Box No. X SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE**

*Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request)*

Sequa Can Machinery, Inc.
By Mitchell D. Bittman
Mitchell D. Bittman, Assistant Secretary

Date 30/10/02

**For receiving Office use only**

| | |
|---|---|
| 1. Date of actual receipt of the purported international application: | 2. Drawings: ☐ received: ☐ not received: |
| 3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application: | |
| 4. Date of timely receipt of the required corrections under PCT Article 11(2): | |
| 5. International Searching Authority (if two or more are competent): ISA / | 6. ☐ Transmittal of search copy delayed until search fee is paid |

**For International Bureau use only**

Date of receipt of the record copy by the International Bureau:

123
122

*This sheet is not part of and does not count as a sheet of the international application.*

# PCT

**FEE CALCULATION SHEET**

**Annex to the Request**

For receiving Office use only

International Application No.

Date stamp of the receiving Office

Applicant's or agent's file reference: RM-107(PCT)

Applicant: SEQUA CAN MACHINERY, INC.

**CALCULATION OF PRESCRIBED FEES**

1. TRANSMITTAL FEE . . . . . 240.00 [T]

2. SEARCH FEE . . . . . 450.00 [S]

International search to be carried out by US

*(If two or more International Searching Authorities are competent to carry out the international search, indicate the name of the Authority which is chosen to carry out the international search.)*

3. INTERNATIONAL FEE

**Basic Fee**

Where item (b) of Box No. IX applies, enter Sub-total number of sheets
Where item (b) of Box No. IX does not apply, enter Total number of sheets } ____

[b1] first 30 sheets . . . . . 407.00 [b1]

[b2] ____ (number of sheets in excess of 30) x ____ (fee per sheet) = ____ [b2]

[b3] additional component (only if sequence listing part of description is filed in computer readable form under Section 801(a)(i), or both in that form and on paper, under Section 801(a)(ii)):

400 x ____ (fee per sheet) = ____ [b3]

Add amounts entered at b1, b2 and b3 and enter total at B . . . . 407.00 [B]

**Designation Fees**

The international application contains 91 designations.

5 (number of designation fees payable *(maximum 5)*) x 88 (amount of designation fee) = 440.00 [D]

Add amounts entered at B and D and enter total at I . . . . . 847.00 [I]

*(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled, the total to be entered at I is 25% of the sum of the amounts entered at B and D.)*

4. FEE FOR PRIORITY DOCUMENT *(if applicable)* . . . . . 15.00 [P]

5. TOTAL FEES PAYABLE . . . . . 1552.00 TOTAL

Add amounts entered at T, S, I and P, and enter total in the TOTAL box

☐ The designation fees are not paid at this time.

**MODE OF PAYMENT**

☐ authorization to charge deposit account (see below) ☐ postal money order ☐ cash ☐ coupons

☒ cheque ☐ bank draft ☐ revenue stamps ☐ other *(specify)*:

**AUTHORIZATION TO CHARGE (OR CREDIT) DEPOSIT ACCOUNT**

*(This mode of payment may not be available at all receiving Offices)*

Receiving Office: RO/ US

Deposit Account No.: 19/4970

Date: 30/10/02

Name: Mitchell Buttman

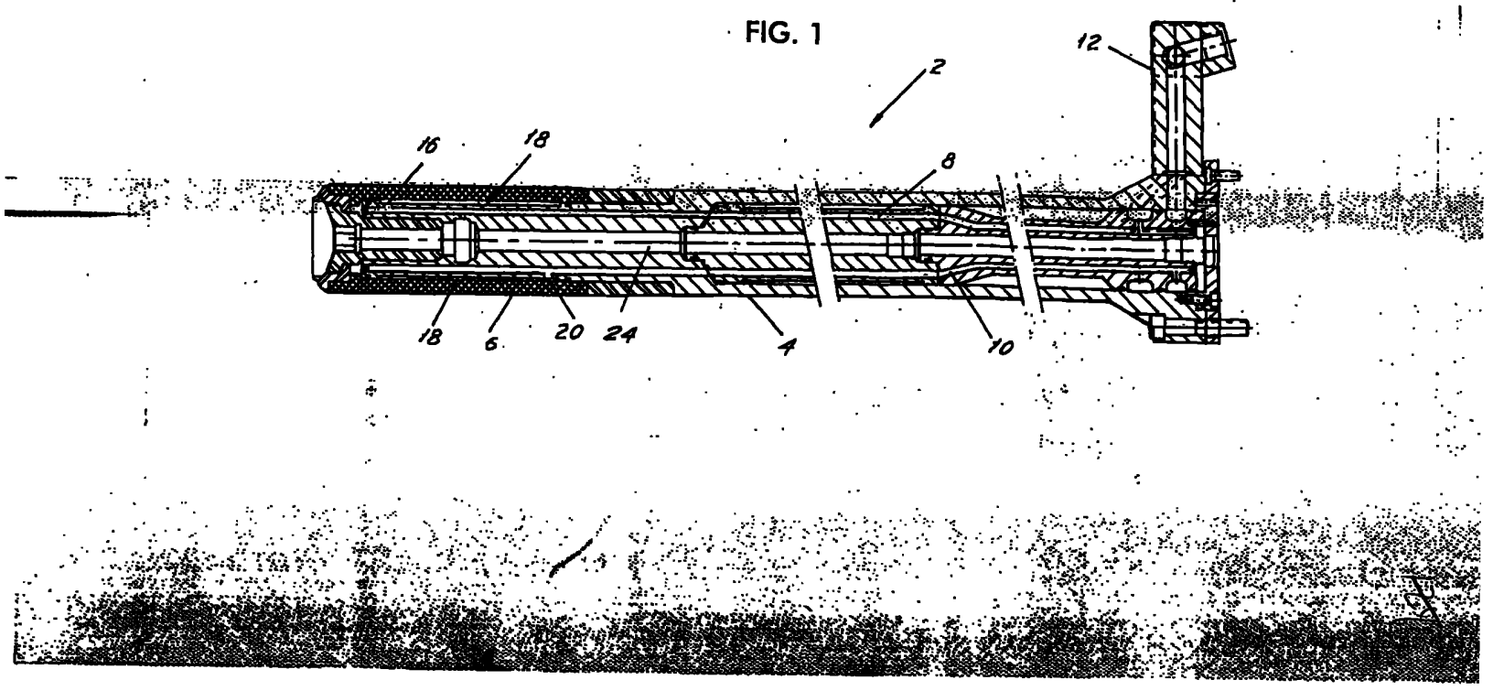
Signature: Mitchell Buttman

☐ Authorization to charge the total fees indicated above.

☒ *(This check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit)* Authorization to charge any deficiency or credit any overpayment in the total fees indicated above.

☐ Authorization to charge the fee for priority document.

FIG. 1



R4

**FORMATO DE DIGITALIZACION**
**RELACION DE ANEXOS**

Royal Technologies S.A.

| Item | Expediente No | 040399 40 | No de Folio |
|---|---|---|---|
| | | No de Unidades | √ |
| 1 | CD | | |
| 2 | DVD | | |
| 3 | REVISTA | | |
| 4 | LIBRO | | |
| 5 | PERIODICO | | |
| 6 | DISQUETES | | |
| 7 | SOBRE DE MANILA | J | |
| 8 | SOBRE BLANCO TAMAÑO CARTA | | |
| 9 | SOBRE BLANCO TAMAÑO OFICIO | | |
| 10 | OTROS: | | |

**Observaciones:** Arte final

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125

SUPERINDUSTRIA Y COMERCIO
Radicacion : 04029940 00000000 Folios: 125
Fecha (AMD): 2004-04-30 16:42:30
Tramite : 011 PCT-PATENT 379 FASE NACI 411 PRESENTAC
Dependencia 2020 DIVISION DE NUEVAS CREACIONES

# REQUISITOS NECESARIOS PARA PRESENTACION Y AGILIZACION DEL TRAMITE

| | USUARIO | RADICADOR |
|---|---|---|
| PATENTE DE INVENCIÓN ✓ MODELO DE UTILIDAD | ( ) | ( ) |
| Indicacion de que se solicita la concesión de una patente | ( ) | ( ) |
| Datos de identificación del solicitante o de la persona que se presenta la solicitud. | ( ) | ( ) |
| Descripcion de la invención | ( ) | ( ) |
| Dibujos de ser estos pertinentes | ( ) | ( ) |
| Comprobante de Pago de las tasas establecidas | | |
| COMPLETA ( ✓ ) INCOMPLETA | ( ) | ( ) |
| DISEÑO INDUSTRIAL ( ) | | |
| Indicacion de que se solicita el registro de Diseño Industrial | ( ) | ( ) |
| Datos de identificación del solicitante o de la persona que presenta la solicitud | ( ) | ( ) |
| Representación grafica o fotografica del Diseño Industrial o muestra del Material que Incorpora el diseño | ( ) | ( ) |
| Comprobante de pago de las tasas establecidas | ( ) | ( ) |
| COMPLETA ( ) INCOMPLETA | ( ) | ( ) |
| ESQUEMA DE TRAZADO ( ) | | |
| Indicacion de que solicita el registro de un Esquema de trazado | ( ) | ( ) |
| Datos de Identificacion del solicitante o de la persona que presenta La solicitud | ( ) | ( ) |
| Representación grafica del esquema de trazado | ( ) | ( ) |
| Comprobante de pago de las tasas establecidas | ( ) | ( ) |
| COMPLETA ( ) INCOMPLETA | ( ) | ( ) |

Firma Responsable

Fecha

Industria y Comercio
SUPERINTENDENCIA

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2020
Bogotá, D.C.,

**Doctor:**
DILIA MARIA RODRIGUEZ D'ALEMAN
Apoderado

**Oficio N°** 05213

| | | |
|---|---|---|
| **ASUNTO:** | Radicación N° | 04-39940 |
| | Solicitud Internacional | PCT/US02/34895 |
| | Fecha inicio fase nacional | 02/06/2004 |
| | Trámite | 011 |
| | Evento | 379 |
| | Actuación | 430 |
| | Folios | 001 |

Como resultado del examen de forma, realizado con fundamento el el artículo 38 de la Decisión 486 de la Comisión de la Comunidad Andina, artículo 27 del Tratado de Cooperación en Materia de Patentes (PCT), regla 51 bis del Reglamento y Circular Única de la Superintendencia de Industria y Comercio, se le comunica que:

- La solicitud no contiene la copia del documento en que consta la cesión del derecho a la patente del inventor al solicitante o a su causante. (Art. 26-k) Decisión 486).
- La solicitud no contiene el poder debidamente otorgado, con el lleno de los requisitos exigidos por los artículos 63 y subsiguientes del Código de Procedimiento Civil. Adicionalmente, deberá presentar el documento que acredita la existencia y representación legal de la sociedad solicitante, cuando ésta fuere persona jurídica.
-

En cumplimiento de lo dispuesto por el artículo 39 de la Decisión 486, se le requiere para que dentro del término de dos meses siguientes a la fecha de notificación del presente oficio, complete los requisitos *anteriormente enunciados. En caso de no dar cumplimiento al presente requerimiento,* la solicitud se considerará abandonada y perderá su prelación.

Notifíquese el presente oficio conforme a lo dispuesto en el numeral 5.2, literal e), del capítulo quinto del título primero de la Circular Única N° 10 de 2001.

**ALIX CARMENZA CESPEDES DE VERGEL**
Jefe de la División de Nuevas Creaciones.

El anterior requerimiento fue notificado por fijación en lista de fecha 21 JUN 2004.

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