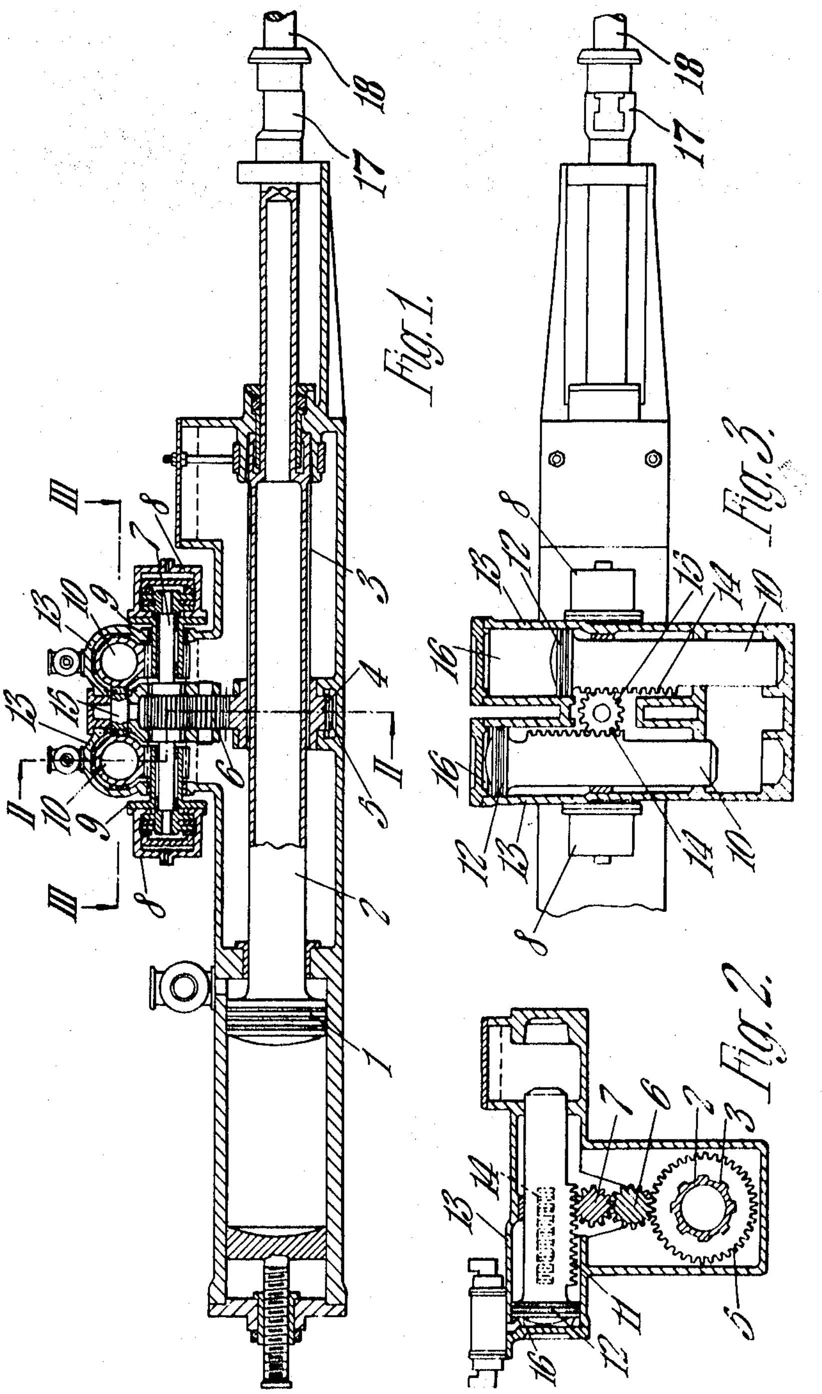
Nov. 2, 1971 JEAN-PAUL CALMES 3,616,670

DEVICE AND METHOD FOR ROTATING THE MANDREL
IN A ROTARY FORGING MILL

Filed July 16, 1969




INVENTOR
JEAN PAUL CALMES

United States Patent Office

3,616,670

Patented Nov. 2, 1971



3,616,670

# DEVICE AND METHOD FOR ROTATING THE MANDREL IN A ROTARY FORGING MILL

Jean-Paul Calmes, En Pernessy, Le Mont-sur-Lausanne, Switzerland

Filed July 16, 1969, Ser. No. 842,118
Claims priority, application Germany, July 31, 1968, P 17 52 888.0
Int. Cl. B21b *17/08*
U.S. Cl. 72—209 7 Claims

## ABSTRACT OF THE DISCLOSURE

The recoil device of a rotary forging mill is enabled to obtain uni-directional rotation of the hollow, or workpiece, between working strokes in such a manner that the angle of rotation is independent of the length of stroke of the recoil piston. There is a shaft operatively connected to the mandrel holder in such a way that rotation of the shaft is transmitted to the mandrel holder. The shaft is rotated by two pressure-fluid operated pistons which can be coupled in turn to the shaft. The pistons are also coupled to each other so that as one piston makes a working stroke the other piston makes a return stroke.

The invention relates to a device and method for rotating the mandrel in a rotary forging mill (often referred to as a Pilger mill).

When producing tubes in a rotary forging mill, it is necessary to rotate the hollow about a certain angle (which is usually 90°) after each rolling stroke in order to use the next rolling stroke to roll out the flashes which are caused by the gap between the edges of the rolls.

In known recoil devices for rotary forging mills, the rotation is generated by means of a helically-threaded spindle and a mating threaded nut and is transmitted to the hollow by way of the mandrel. In this way, the amount of rotation of the hollow depends upon the length of stroke of the recoil piston. A disadvantage of such a device is particularly noticeable during the starting or pointing period because during this first rolling period, the full stroke is not attained and in this way the full rotary movement of the hollow cannot be achieved. In this manner, the bevelled edges of the roll pass and the gaps between the edges of the rolls cause thick flashes or buckling to be formed on the hollow wall; due to the small rotation of the hollow, the rolls turn the hollow back a number of times into its initial position. When, after a number of strokes of the rotary forging mill, the rotation of the hollow is finally large enough, this thick flashing must be rolled out to a thin wall thickness in one pass through the rolls so that the rolls and their bearings are subjected to high or dangerous stresses. A further disadvantage results from the undesirable dependency of the angle of rotation of the hollow on the diameter of the rotary forging rolls because the diameter of the rotary forging rolls is one of the factors determining the length of stroke of the recoil piston. For this reason, it is not easily possible to set the angle of rotation of the hollow exactly for different dimensions of the rotary forging rolls.

Another disadvantage of rotating the hollow by means of a helically-threaded spindle is that a part of the energy formed behind the recoil piston by compression of the recoil air is used for the rotary movement of the hollow and not for the return movement of the recoil piston in order to achieve a higher recoil speed.

For these reasons, there has been no lack of attempts



and suggestions to make the rotary movement of the hollow independent of the recoil movement. Nonetheless, the devices proposed have disadvantages. Thus it has been suggested to turn the hollow by means of a rack mounted at right angles to the recoil direction. The disadvantage of this device is that although the hollow can indeed be turned through the required angle during the return stroke of the recoil piston, during the following return stroke, the rotation of the hollow can only be effected in the opposite direction. Thus during the course of the rotary forging process, the hollow does not completely rotate, but merely oscillates to and fro about its longitudinal axis. The cooling water used during rolling only acts on about a quarter of the periphery of the hollow so that this part of the periphery is more strongly cooled and shrinks (compared to the remainder of the hollow) and the tube being formed can bow upwardly during the rotary forging process.

According to a *first aspect* of this invention, there is provided a device for rotating the mandrel holder in a rotary forging mill, the device having

two pistons movable in respective cylinder spaces,
an inlet for supplying pressure fluid to the respective cylinder space so that the respective piston makes a working stroke and an outlet for exhausting the pressure fluid from the cylinder space,
interconnecting means interconnecting the two pistons such that one piston makes a return stroke to its initial position while the other piston makes its working stroke, and vice versa,
a shaft for linking to the mandrel holder to transmit rotary movement of the shaft to the mandrel holder,
linking means including a disengageable coupling linking each said piston to the shaft such that the working strokes of the pistons rotate the shaft in the same direction, and
means for engaging the respective coupling for the working stroke of the piston and for disengaging the coupling for the return stroke of the piston.

According to a *second aspect* of this invention, there is provided a recoil device for a forging mill, the recoil device having

a recoil cylindner,
a recoil piston movable in the recoil cylinder,
a mandrel holder connected to the recoil piston, and
a device according to the first aspect of the invention for rotating the mandrel.

According to a *third aspect* of the invention, there is provided a rotary forging mill having a recoil device and a rotating device in accordance with the first aspect of the invention.

According to a *fourth aspect* of the invention, there is provided a method of rotating the mandrel holder when operating a rotary forging mill according to the third aspect of the invention, including engaging one said coupling and supplying pressure fluid to the inlet of the respective cylinder space during the return stroke of the recoil piston to rotate the mandrel holder whilst at the same time the other coupling is disengaged and the other piston in the other said cylinder space makes a return stroke, and disengaging the first coupling and engaging the other coupling to connect the other piston with said shaft.

Thus using the invention, it is possible to obtain uni-directional rotation of the hollow in such a manner that the angle of rotation is independent of the length of stroke of the recoil piston.

In general, racks can be connected to each said piston for transmitting the movement of the piston to said shaft and/or to the other piston, and the pistons can be formed as an integral piston head on the respective rack.

The interconnecting means may comprise a toothed rack connected to each said piston, the lines of action of the racks being parallel, and an idling gear wheel positioned between the racks and meshing with each rack.

The linking means may comprise a toothed rack connected to each said piston, a toothed member connected to the respective coupling meshing with the respective rack.

The coupling engaging and disengaging means are preferably arranged to be operated by compressed gas, and may for instance be of the multi-plate type.

The mandrel holder is normally connected to the recoil piston by way of a piston rod, and the shaft of the rotating device may be linked to the piston rod.

In operation, the couplings are preferably engaged and disengaged during the working stroke of the recoil piston.

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a longitudinal section through a device in accordance with the invention;

FIG. 2 is a section along the line II—II of FIG. 1; and

FIG. 3 is a section along the line III—III of FIG. 1.

FIG. 1 shows part of the recoil device of a rotary forging mill. A piston rod **2** of a recoil piston **1** has rectilinear lands or splines **3** passing through a mating rotary ring **4**. The outer end of the piston rod is connected to a holder **17** for a mandrel **18**. The ring **4**, which carries external toothing **5**, is rotatably mounted in the housing of the recoil device. The ring **4** is connected with a shaft **7** by means of an intermediate gear wheel **6** which is also mounted in the housing of the recoil device, the shaft **7** having a toothed middle section and being rotatably mounted in the housing of the recoil device. Each outer end of the shaft **7** carries a pneumatically-operating multi-plate clutch **8** flanged to a toothed coupling sleeve **9**. Two toothed racks **10** are mounted above the shaft **7** and at right angles to the axis of the shaft **7**, the teeth **11** on the under sides of the racks **10** meshing with the teeth on the respective coupling sleeve **9**. The ends of the racks **10** are in the form of pistons **12** which move in cylinders **13**, which cylinders can be supplied with compressed gas. The facing sides of the racks **10** have teeth **14**. An idling gear wheel **15** is mounted between the two racks **10** in such a way that it meshes with the teeth **14** of each rack **10**.

In the view of FIG. 3, the left-hand rack **10** is in its working position. During the previous working stroke of the recoil piston rod **2**, this rack **10** was connected with the shaft **7** by way of the left-hand pneumatic clutch **8** and the toothed coupling sleeve **9**. At the beginning of the return stroke of the recoil piston rod **2**, compressed gas is supplied to the left-hand space **16** (as seen in FIG. 2) of the cylinder **13**, synchronised with the rotation of the rotary forging rolls. The recoil piston rod **2**, which is now making its return stroke, and also the hollow (not shown), is rotated about its axis by the movement of the left-hand rack **10**, transmitted by way of the shaft **7**, the intermediate gear wheel **6** and the ring **4**, the movement of the left-hand rack **10** being from left to right as shown in FIG. 2. The stroke of the rack **10** is set so that the desired angle of rotation is exactly reached; at the end of its stroke, the rack **10** is braked by an oil-hydraulic dash-pot similar to that used for braking the return stroke of the recoil piston. During the movement of the left-hand rack **10**, the uncoupled right-hand rack **10** is driven back into its initial position by means of the idling gear wheel **15**. During the following working stroke of the recoil piston rod **2**, the left-hand clutch **8** is exhausted, thereby releasing the connection between the left-hand rack **10** and the shaft **7**, whilst at the same time the right-hand clutch **8** is subjected to compressed gas so that the right-hand rack **10** is now connected with the shaft **7** by way of the toothed coupling sleeve **9**. Thus at the beginning of the following return stroke of the recoil piston rod **2**, the right-hand rack **10** is in its working position and the rotation of the recoil piston rod **2** which has already been described in connection with the left-hand rack **10** can now take place in the same direction by passing compressed gas into the space **16** of the right-hand cylinder **13**.



Using the invention, it is possible to provide a device and a process in which the rotation of the hollow can be precisely carried out both during the starting or pointing period and during the main rotary forging process, independently of the return movement of the recoil piston rod. The length of the return stroke of the recoil piston rod has no influence on the angle through which the hollow is rotated so that the angle of rotation can be set more exactly. In this way, square-section tubes can be produced by setting the angle precisely to 90° or decagonal, hexagonal or octagonal tubes can be rolled with appropriate setting of the angle of rotation. A further advantage is that the rotary forging operation can be carried out with a smaller return pressure because the rotation of the hollow is independent of the return movement of the recoil piston, or, alternatively, with the same return pressure (which is only used for the rectilinear return movement of the recoil piston), the rotary forging process can be carried out at higher recoil speeds and thus at higher speeds of rotation of the rotary forging rolls.

I claim:

**1.** A device for rotating the mandrel holder in a rotary forging mill, the device having

two pistons movable in respective cylinder spaces,

an inlet for supplying pressure fluid to the respective cylinder space so that the respective piston makes a working stroke and an outlet for exhausting the pressure fluid from the cylinder space,

interconnecting means interconnecting the two pistons such that one piston makes a return stroke to its initial position while the other piston makes its working stroke, and vice versa,

a shaft for linking to the mandrel holder to transmit rotary movement of the shaft to the mandrel holder,

linking means including a disengageable coupling linking each said piston to the shaft such that the working strokes of the pistons rotate the shaft in the same direction, and

means for engaging the respective coupling for the working stroke of the piston and for disengaging the coupling for the return stroke of the piston.

**2.** A device as claimed in claim **1**, wherein the interconnecting means comprises respective toothed racks connected to each piston, the lines of action of the rack being parallel, and an idling gear wheel positioned between the racks and meshing with each rack.

**3.** A device as claimed in claim **1**, wherein the linking means comprises respective toothed racks connected to each said piston, a toothed member connected to the respective coupling meshing with the respective rack.

**4.** A device as claimed in claim **1**, wherein the coupling engaging and disengaging means is operated by compressed gas.

**5.** A device as claimed in claim **1**, including a recoil cylinder, a recoil piston movable in the recoil cylinder, means rigidly connecting said mandrel holder to said recoil piston, and means operatively connecting said shaft to said connecting means for rotating the latter.

**6.** A method of rotating a mandrel holder when operating a rotary forging mill, comprising operatively connecting a piston in a cylinder with said mandrel holder for rotating the holder in a predetermined direction when the piston is moved in one direction, supplying fluid pressure to said cylinder to move said piston in said one direction, shutting off said fluid supply and disconnecting said piston from the mandrel holder, operatively connecting a piston in a second cylinder with the mandrel holder for rotating the holder in said predetermined direction, supplying fluid pressure to said second cylinder to move the piston therein, and returning the piston in either cylinder to the opposite end thereof while fluid pressure is being supplied to the other cylinder.

**7.** A method as claimed in claim **6**, including moving the mandrel holder back and forth in opposite directions, operatively connecting the pistons to and disconnecting them from the mandrel holder only while it is moving in one of said opposite directions, and supplying the fluid pressure to a cylinder only while the mandrel holder is moving in the other of said opposite directions.




**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 1,028,236 | 6/1912 | Ludwig | 72—209 |
| 1,986,691 | 1/1935 | Uebelhart | 72—209 |
| 2,775,150 | 12/1956 | McLay | 72—208 |
| 2,914,973 | 12/1959 | Crane | 72—208 |



CHARLES W. LANHAM, Primary Examiner

G. P. CROSBY, Assistant Examiner

U.S. Cl. X.R.

72—419, 449