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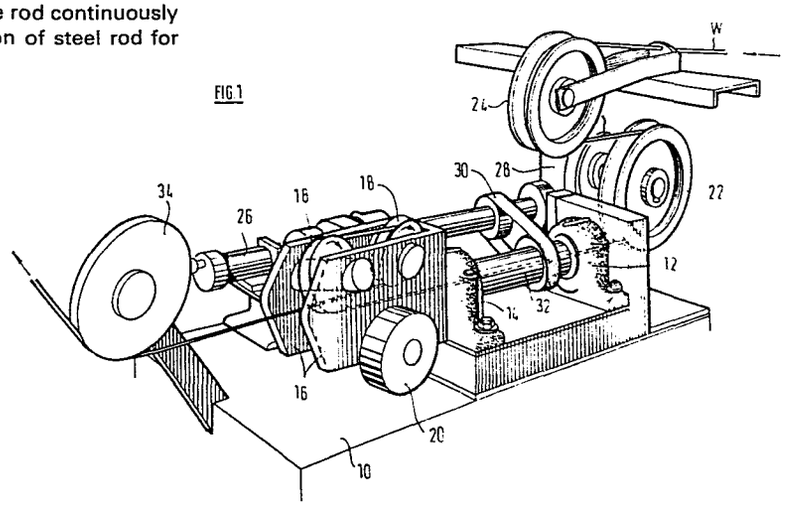
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(54) Apparatus for cold working of metal rod.

(57) Apparatus for the cold working of hot rolled steel rod comprises at least two freely rotatable pulleys (18) driven by a motor (26) for orbital revolution for imparting a substantial degree of cold working to the rod as it is fed continuously through the apparatus. The rod is twisted in one direction as it enters the pulley system and is twisted in the opposite direction as it leaves the pulley system. The apparatus operates also to descale and straighten the rod continuously and is particularly useful in the production of steel rod for welded mesh in reinforcing concrete.

FIG 1



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Apparatus for Cold Working of Metal Rod

The invention relates to apparatus for cold working of metal rod.

It is known that the cold working of for example steel rod will improve its mechanical properties, in particular its tensile strength, and such cold working is usually effected either by rolling or drawing. Thus in the production of steel rod for use in forming welded mesh for concrete reinforcement, the material may initially be hot rolled and then cold drawn or cold rolled in order to achieve the necessary standard specification relating to its tensile strength. Such specifications usually state that the ratio of the ultimate tensile stress to the proof stress shall be more than a specified value. For rod used in concrete reinforcing meshes the ratio specified is 1.05 : 1 in most European specifications.

Such rods may have a smooth surface or may be provided with surface deformations such as ribs to improve their keying or bonding capability to the concrete.

The most convenient way of introducing surface deformations such as ribs is during the hot working stage, but these deformations do not survive the normal cold working techniques of cold drawing or cold rolling. Deformations can be introduced during a final cold rolling operation but their production requires excessive local working of the material and there is a high mechanical energy requirement. It is difficult or impossible to provide suitable deformations in a cold drawing operation.

It is known to hot roll deformations into reinforcing material, to cut the material into bars of finite length and then cold work by twisting. This procedure is not

suitable for long lengths of rod which are normally stored in coil form and require a cold working technique which can be effected on an indefinite length of the rod.

It is known from West German patent specification 909562 to twist and subsequently untwist an indefinite length of thin metal rod by passing the rod continuously through an apparatus incorporating an orbital pulley. The rod is wrapped one complete turn round a pulley which is then arranged to orbit about an axis corresponding to the tangent to the pulley at which the rod joins and leaves the pulley. Power for this orbiting motion is derived from the rotation of the pulley about its own axis caused by pulling the rod through the apparatus. The degree of twist and subsequent untwisting used in this German patent is of the order of one turn in a length equivalent to more than 50 rod diameters. Twisting to this extent is sufficient to achieve the intended purpose of the German specification, namely a breaking up of scale on the surface of the rod to facilitate subsequent removal of this scale. This degree of twist is entirely inadequate for producing a significant increase in strength of the material as can be judged from the German specification itself which utilises the twisting and untwisting as a preliminary to cold working of the rod by drawing it through a die. Thus the apparatus of the German specification is not put forward as a solution to the problem of cold working continuous lengths of rod and would not be suitable for that purpose for several reasons in addition to the limited degree of twist. The part of the rod leaving the pulley rubs closely against the part of the rod entering the pulley which may be helpful as an adjunct to descaling but would cause unacceptable snagging of rod for cold working, particularly for rod which does not have a smooth surface. Also, the power which can be generated by pulling the rod through the apparatus is

normally insufficient to carry out the degree of cold working necessary to produce a useful increase in rod strength. The rod tends to break under the high tension which needs to be generated.

According to the present invention apparatus for the cold working of metal rod comprises a pulley system around which the rod can be passed continuously from an input side to an output side and drive means for orbiting the pulley system about an axis other then the axis of rotation of the pulley whereby the rod is continuously twisted in one direction at the input side of the pulley system and is continuously untwisted at the output side thereof and is characterised in that the pulley system comprises at least two pulleys.

By providing more than one pulley in the pulley system, it is possible to provide a path for the rod through the apparatus such that two parts of the rod do not come into contact and bind against each other. By this means the power requirement of the apparatus in relation to the degree of twisting is reduced and the apparatus can operate without snagging of the rod which would be a particular problem with an indented rod surface.

It may just be possible in some circumstances to use only the power generated by tension in the rod to drive the pulley system, for example in the case of rod which increases in strength readily with very limited cold working, but normally a separate source of power should be provided to rotate the pulley system about its axis of rotation.

The apparatus may comprise a restraint pulley upstream of the input side of the pulley system and around which

the rod is passed before it is fed to the pulley system thereby to ensure that the rod is twisted in the said one direction between the restraint pulley and the pulley system.

The orbiting pulley system and the restraint pulley may be driven in synchronism whereby the speed of orbiting of the pulley system is at a predetermined rate with respect to the speed of input of the rod to the pulley system from the restraint pulley.

The pulley system may comprise two pulleys spaced out longitudinally of the pulley system axis and arranged with their axes transverse to the axis of rotation of the system and with a tangent to each of their peripheries generally along the axis of the system, the rod path leading to a first of the pulleys generally along the axis of the system after passing the second pulley, reversing around the first pulley and returning to the second pulley, reversing around the second pulley and going past the first pulley generally along the axis of the system, the pulleys being mutually offset to allow the incoming rod to the first pulley to be spaced from the outgoing rod from the second pulley.

In an alternative arrangement the pulley system comprises three pulleys spaced out longitudinally of the pulley system with their axes transverse to the system axis. The first and third pulleys each having a tangent generally along the system axis and the second pulley lying between the first and third pulleys whereby a rod path is deflected away from the system axis around the first pulley, passes over the second pulley and is then deflected back generally along the system axis around the third pulley.

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In use of this apparatus, the rod has its tensile strength increased by cold work associated with twisting and untwisting. Within the apparatus, the rod is also effectively descaled and is straightened.

Embodiments of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a perspective view of one form of apparatus for cold working of rod

Figure 2 is a side elevation of an alternative apparatus in accordance with the invention for cold working rod

and

Figure 3 is a plan view of the apparatus shown in Figure 2.

As illustrated in figure 1, the apparatus includes a fixed frame 10 upon which are mounted two plummer block bearings 12 and 14 for a hollow rotatable shaft 32. Each of the bearings 12 and 14 is centrally apertured with the apertures in alignment with each other. Outboard of the bearing 14, a stirrup shaped yoke is mounted on the end of the shaft 32, the yoke including two opposed parallel side plates 16 between which are mounted two freely rotatable pulleys 18. The pulleys 18 are carried in the yoke adjacent one edge thereof in such a way that a tangent to each of their peripheries lies generally along the axis of shaft 32. At the other edge of the yoke counter-balance weights 20 are mounted. The axes of the pulleys 18 are transverse to the axis of shaft 32 and are skewed slightly relative to each other so that the pulleys 18 are slightly offset from each other, particu-

larly in the region of the axis of shaft 32. The pulleys 18 together with the yoke 16 form a pulley system which is rotatable about a pulley system axis corresponding to the axis of shaft 32.

At the input side of the apparatus there is a relatively large diameter restraint pulley 22 the lower edge of which is in alignment with the axis of the shaft 32. A V-groove in pulley 22 provides drive between the rod and pulley. Rod curved round the pulley acts as a lever arm to hold it against rotation of the pulley system. Located above and forward of the restraint pulley 22 is a freely rotatable guide pulley 24 onto which is fed the rod W from a convenient source such as a reel thereof. The direction of input of the rod W is shown by the arrow in the drawing.

At the rear of the apparatus there is mounted an air or electrically actuated controllable torque motor 26 which is coupled to the restraint pulley 22 through a suitable gear box 28. The motor 26 is also coupled to rotate the shaft 32 and the yoke through a toothed belt or similar drive 30 so that the pulley system incorporating pulleys 18 is orbitable about the axis of shaft 32. The pulley system is thus driven in synchronism with the restraint pulley 22 to provide a predetermined speed of orbiting with respect to the speed of input of the rod over pulley 22.

The rod is pulled through the apparatus, for example from a rotating spool. The rod is arranged to grip the restraint pulley 22 and if the rod tension after the pulley 22 is greater than that before the pulley, it transmits energy via the gear box 28 to the shaft of the motor 26 and hence to the yoke shaft 32, to contribute to the energy required for twisting.

In use, the rod W to be cold worked runs from a stock reel thereof around the two pulleys 24 - 22, through the hollow rotatable shaft 32, and around both pulleys 18 in the pulley system before exiting around a reaction pulley 34. The rod meets up with the pulley 34 at a point on the axis of shaft 32. Thus the output of the rod at pulley 34 is co-axial with its input from pulley 22. Rod leaving pulley 34 at an angle acts as a lever arm to hold the rod against rotation. The rod passes continuously through the apparatus and is twisted in one direction between the restraint pulley 22 and the orbiting pulley system and is then twisted in the opposite direction as it passes between the output side of the pulley system and the reaction pulley thereby imparting a substantial degree of cold working to the rod.

Cold worked rod produced by the apparatus is particularly suitable for use in concrete reinforcing mesh where cut lengths of the cold worked rod have to be welded together. In particular the rod fed through the apparatus may be ribbed transversely, as is known practice in use of reinforcing rod for concrete, and the skewed axes of the orbiting pulleys 18 particularly ensure that such ribbed rod does not snag or chafe upon itself between the input and output sides of the pulley system. Also the rod is effectively descaled due to the distortion of its surface and straightened by the twisting and untwisting under tension whereby it may be immediately cut and welded for use in concrete reinforcing mesh.

An alternative form of the apparatus is shown in figures 2 and 3 of the drawings comprising a frame structure having a pair of aligned apertured plummer block bearings 40 and 42 thereon between which is mounted an orbital pulley system comprising three in-line freely rotatable pulleys 44 - 46 - 48 which are spaced out longitudinally

of the pulley system. The pulleys are mounted in a yoke 50 with their axes of rotation parallel to one another and normal to the orbital axis of rotation of the system i.e. the axis of the centre lines of bearings 40 - 42. The yoke 50 with its freely rotatable pulleys 44 - 46 - 48 is driven for orbital rotation through a gear wheel system 52 from an input drive shaft 54 itself driven from the motor which drives the coiler (not illustrated).

Rod to be cold worked enters the apparatus around a guide pulley 56, over a brakable rotational restraint pulley 58, through the upstream plummer block bearing 40, around the pulley system 44 - 46 - 48, through the downstream plummer block bearing 42 and exits to the coiler around a further restraint pulley 60 and guide pulley 62. Pulleys 44 and 48 are each arranged so that they have a tangent generally along the pulley system axis so that rod enters and leaves the pulley system along this axis. The rod path is deflected from the pulley system axis around pulley 44, passes over pulley 46 and is then deflected back along the pulley system axis around pulley 48. Because the orbital drive to the pulley system is derived from and made to be in synchronism with the drive to the coiler which pulls rod through the system, orbital rotation of the pulley system is in synchronism with the passage of rod through the system. This ensures that the pitch of twisting and untwisting of the rod always remains constant, regardless of the speed of operation of the apparatus. Predetermined tension is imparted to the rod by the brakable pulley 58 which has means associated therewith for adjusting the degree of braking effort imparted to the rod.

Figure 2 shows that the centre pulley 46 of the three freely rotatable pulleys in the orbital system is withdrawable downwardly of the yoke 50 to facilitate initial

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threading of the rod through the system and is thereafter moved upwardly into the position shown in figure 2 so that, in the orientation of the yoke shown in this drawing, the rod passes over the centre pulley 46 and under the two outer pulleys 44 and 48.

Thus, in use, the rod is fed from a stock coil thereof continuously through the apparatus and is twisted in one direction between the brakable pulley 58 and the pulley system at the input side thereof and is then twisted in the opposite direction as it leaves the output side of the pulley system between it and the guide pulley 60 thereby imparting a substantial degree of cold working to the rod.

Cold worked rod produced by the apparatus is particularly suitable for use in concrete reinforcing mesh where cut lengths of the cold worked rod have to be welded together. In particular, the rod fed through the apparatus may have previously been ribbed transversely, as is known practice in use of reinforcing rod for concrete. The rod is not only cold worked but effectively descaled as it passes through the apparatus. If the rod is also pulled through the apparatus by a straight line puller rather than being coiled onto a rotating pulley, the untwisting at the output side of the pulley system straightens the rod prior to cutting to length and welding into mesh. Such a straight line puller should of course be driven in synchronism with the drive to the orbital pulley system.

Rod produced in accordance with the invention may be used for concrete reinforcement in the form of simple rods. Alternatively, lengths of rod may be secured together, preferably by welding to form concrete reinforcement mesh.

CLAIMS

1. Apparatus for cold working of metal rod comprising a pulley system around which the rod can be passed continuously from an input side to an output side and drive means for orbiting the pulley system about an axis other than the axis of rotation of the pulley whereby the rod is continuously twisted in one direction at the input side of the pulley system and is untwisted at the output side thereof, characterised in that the pulley system comprises at least two pulleys.

2. Apparatus as claimed in Claim 1 further comprising a restraint pulley upstream of the input side of the pulley system and around which the rod is passed before it is fed to the pulley system thereby to ensure that the rod is twisted in the said one direction between the restraint pulley and the pulley system.

3. Apparatus as claimed in Claim 2 wherein both the orbiting pulley system and the restraint pulley are driven in synchronism whereby the speed of orbiting of the pulley system is at a predetermined rate with respect to the speed of input of the rod to the pulley system from the restraint pulley.

4. Apparatus as claimed in claim 1 or claim 2 or claim 3 wherein the pulley system comprises two pulleys spaced out longitudinally of the pulley system axis and arranged with their axes transverse to the axis of rotation of the system and with a tangent to each of their peripheries generally along the axis of the system; the rod path leading to a first of the pulleys generally along the axis of the system after passing the second pulley, reversing around the first pulley and returning to the second pulley, reversing around the second pulley and going past the first pulley generally

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along the axis of the system; the pulleys being mutually offset to allow the incoming rod to the first pulley to be spaced from the outgoing rod from the second pulley.

5. Apparatus as claimed im claim 1 wherein the drive means for orbiting the pulley system is driven by means other than the rod itself, in synchronism with means for pulling the rod through the apparatus.

6. Apparatus as claimed in claim 1 or claim 5 wherein the pulley system comprises three pulleys spaced out longitudinally of the pulley system with their axes transverse to the system axis, the first and third pulleys each having a tangent generally along the system axis and the second pulley lying between the first and third pulleys whereby a rod path is deflected away from the system axis around the first pulley, passes over the second pulley and is then deflected back generally along the system axis round the third pulley.

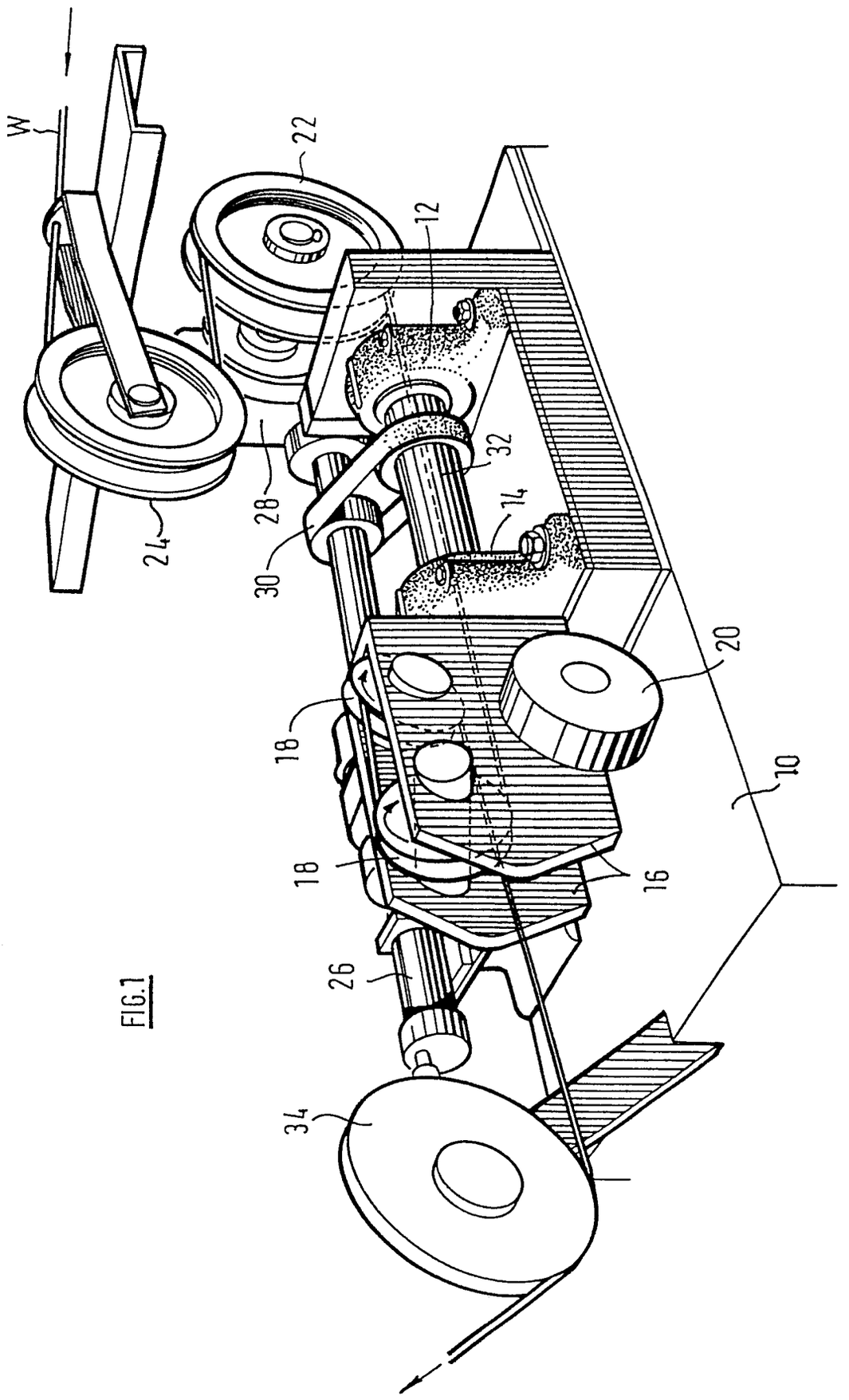


FIG.1

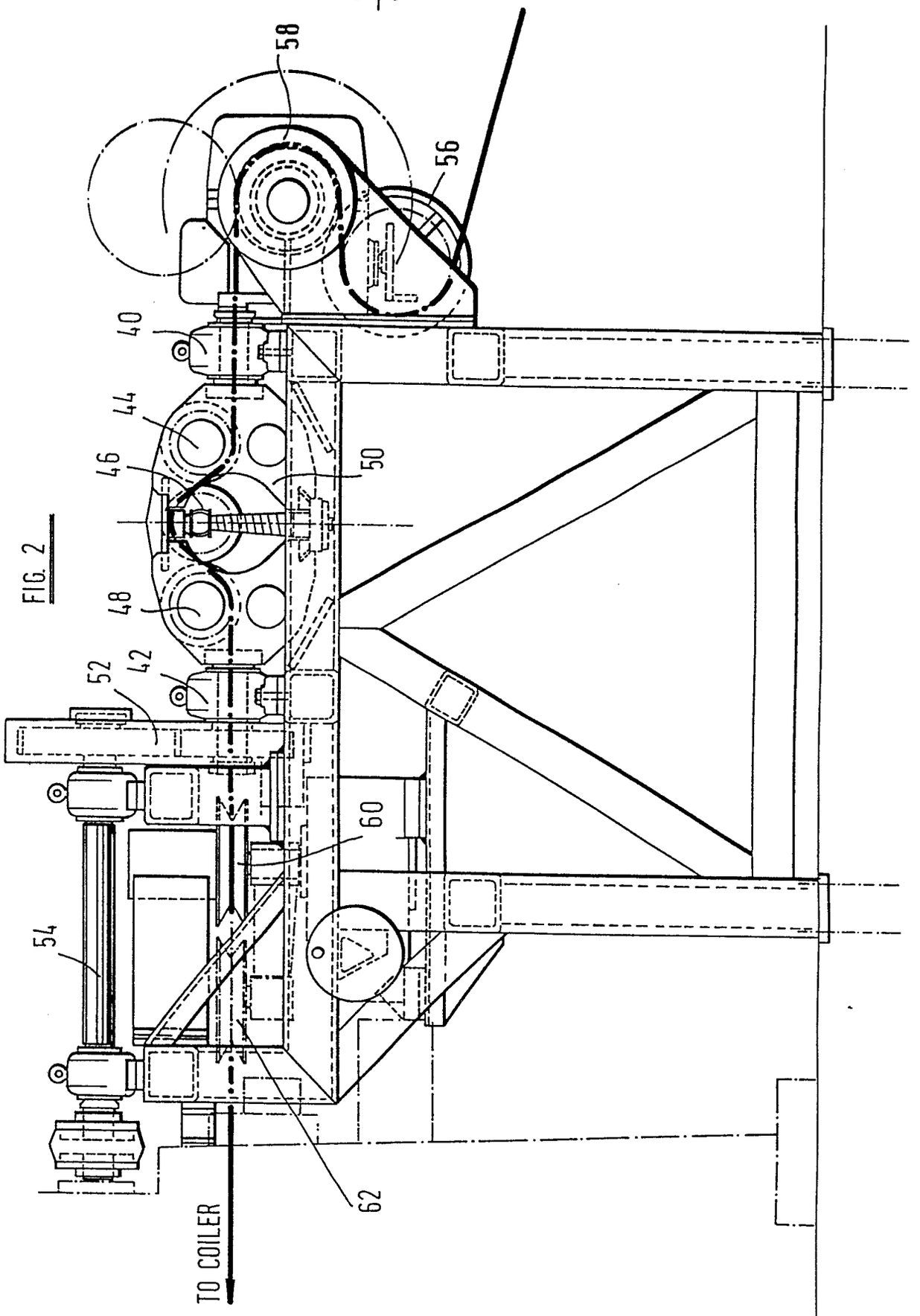
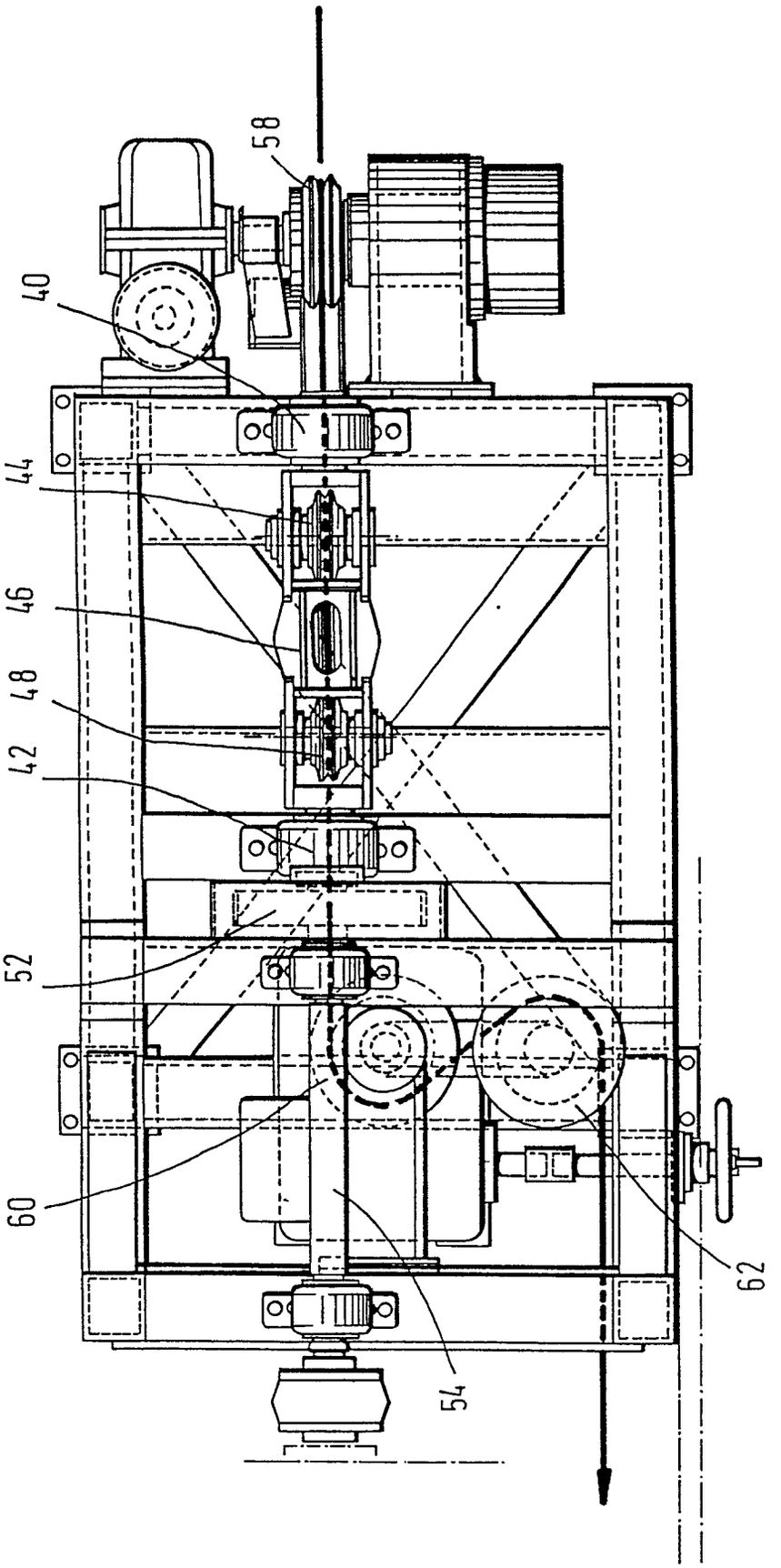


FIG. 2

FIG. 3



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EUROPEAN SEARCH REPORT

0080832
Application number

EP 82 30 6140

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	US-A-4 075 880 (COPELAND) * Claims 1, 2, 5, 6 ; figures 1, 5-7 *	1,2	B 21 D 3/12 C 21 D 7/10
A	DE-B-1 602 624 (BAU-STAHLGEWEBE GMBH) * Claim 1 *		
A	DE-C- 805 533 (EISENWERK NÜRNBERG)		
A	CH-A- 216 746 (KÖHLER)		

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

B 21 D 3/00
B 21 D 11/00
C 21 D 7/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	18-01-1983	SCHLAITZ J

CATEGORY OF CITED DOCUMENTS

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