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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :
B65H 19/22, 18/26

A1

(11) International Publication Number: **WO 94/18104**

(43) International Publication Date: 18 August 1994 (18.08.94)

(21) International Application Number: PCT/US94/01174

(22) International Filing Date: 31 January 1994 (31.01.94)

(30) Priority Data:
08/013,530 4 February 1993 (04.02.93) US

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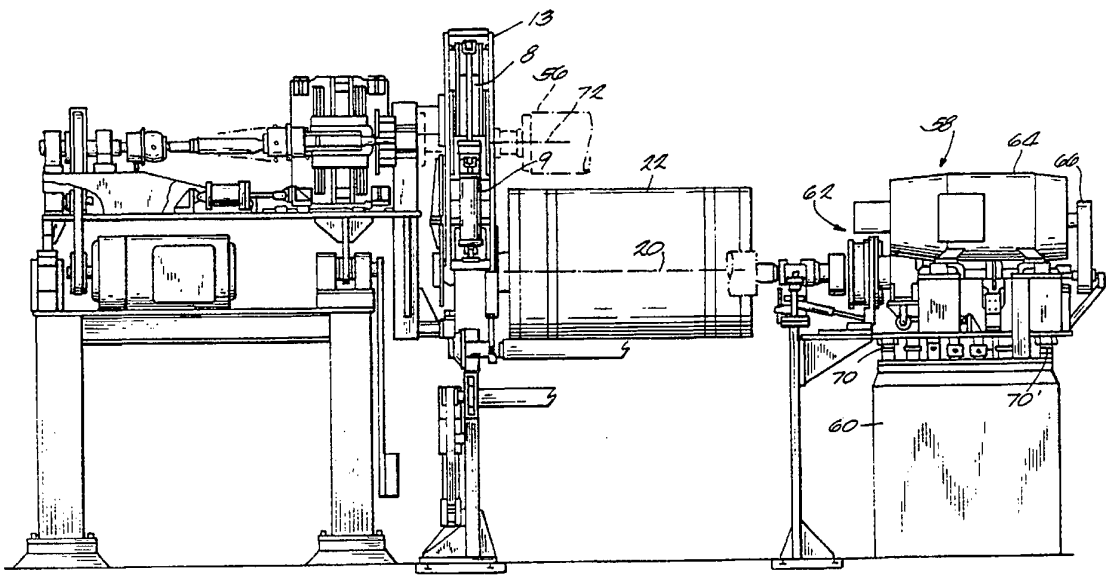
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(81) Designated States: BR, CA, FI, JP, KR, PL, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: REEL FOR A PAPERMAKING MACHINE



(57) Abstract

A Pope-type reel (12) for use on a papermaking machine to wind a substantially continuous, traveling paper web (W) into successive wound paper rolls has a primary drive stand (14) which pivots co-axially with the rotational axis (20) of the reel support drum (22). A primary reel spool drive (32) is mounted to the primary drive stand to provide torque to the reel spool (56) from the initial winding of the traveling paper web onto the reel spool while it is supported by a pair of primary arms (13, 13') over the upper periphery of the support drum (22) until the reel spool is rotated downwardly by the primary arms onto a pair of horizontal guide rails (68, 68'). At this time, the reel spool drive is disengaged, and a secondary reel spool drive (58) engages the now partially wound web roll to provide torque continually until the paper web roll is completely wound.

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PATENT APPLICATION

Reel for a papermaking machine

Background Of The Invention

Field Of The Invention

This invention relates to a reel for winding a traveling, substantially continuous web. More particularly, this invention relates to a reel for winding the paper sheet produced on a papermaking machine. Still more particularly, this invention relates to an improved Pope-type reel on a papermaking machine. Such a reel incorporates a driven support drum about which a pair of primary arms are co-axially mounted. The primary arms accept a reel spool, bring it into engagement with the support drum at a location about the upper periphery thereof, and rotate the reel spool about the support drum and deposit it onto a pair of horizontally disposed guide rails. The paper sheet begins to be wound about the reel spool at its location about the upper periphery of the support drum and is wound into a partial wound paper roll by the time the reel spool is deposited onto the guide rails.

Description Of The Prior Art

Wound paper rolls must be structured properly to avoid inducing web defects during the winding process. The so-called Pope-type reels, while mechanically effective, tend to produce wound rolls of paper where the paper wound near the reel spool, such as from about 5 cm to about 15 cm from the reel spool surface, is defective, such as by having so-called core bursts, wrinkles, tears or other defects generally related to excessive

compression during the winding process. It is imperative that the initial web wraps on the core, or reel spool, are tight enough to avoid layer-to-layer slippage and bursting. However, the paper web cannot be wrapped too tightly since its wound-in tension cannot exceed the paper sheets' tensile strength.

In the paper web reeling process, the tension in the paper sheet of each successive layer tends to relieve the wound-in tension in the paper web beneath it. As the diameter of the wound paper roll increases, it has been determined that each successive web wrap on the roll should be wound with slightly less tension in order to minimize the reduction in the wound-in tension in the web layers beneath it.

Heretofore, in Pope-type reels, such control of the wound-in tension has been very difficult, if not impossible, to control since each new core, or reel spool, has been driven during the initial reeling stage, when the diameter of the wound paper roll is small, either by nipping contact with the support drum or by external contact with a nipped drive roll, such as a rubber covered tire, or both. In any event, the wound-in tension of the web on the new reel spool was provided essentially by the nipped frictional engagement of the reel spool against the support drum with the paper web in-between.

Therefore, during the period of time during the early stages of the reeling process, when the newly formed wound paper roll is perhaps between about 5 - 15 cm in radial thickness, the wound-in tension is produced essentially by the frictional nipping engagement of the reel spool against the support drum. This is while the reel spool is supported by the primary arms over and against the upper periphery of the support drum. The wound-in tension produced this way is insufficient to prevent defects

near the core, particularly when the wound paper rolls become large in diameter, such as about 250 cm or larger.

After the reel spool, with the initially wound layers of paper web on it, has been deposited on the guide rails, in current Pope-type reels, a drive is connected to the reel spool to provide torque to drive the wound paper roll to provide the desired wound-in web tension while the wound roll is held in nipping engagement with the driven support drum.

It has been determined that the three winding parameters influencing the desired hardness of wound paper rolls are 1) the linear nip pressure between the wound paper roll and the support drum; 2) the tension in the in-coming paper sheet; and 3) the torque applied to the reel spool/core of the paper roll being wound.

When nip pressure is the only wound web roll structuring technique utilized in producing the roll, there are limitations inherent in both the grades of paper which can be wound in this manner, and in the amount of nip pressure which can be effectively applied between the reel spool and support drum. For example, paper grades sensitive to nip pressure, such as creped and carbonless forms, cannot be wound at high nip pressures without adversely affecting the paper quality. Also, high nip pressures cannot effectively be applied to steel reel spools since steel spools do not possess sufficient compressibility, or ability to deform, to function properly in nipping engagement. Finally, low nip pressures alone will frequently not provide enough friction to drive the paper roll being wound.

Another limiting operational characteristic affecting the ability of current design Pope-type reels to wind a paper sheet effectively is that the range of tension in the in-coming paper sheet is limited to a relatively

narrow range. Thus, while a greater sheet tension might be desired for the purposes of producing a more desirable roll structure, it might increase the frequency of sheet breaks and, therefore, not be feasible.

Another aspect of this design insures proper speed match between the spool and drum until the spool is brought into nipping contact with the drum. Conventional wind-ups use surface driving to accelerate the new spool to web speed. These drives lose contact with the spool prior to making nipping contact with the drum. An over-speeding or under-speeding spool causes web breaks during the web transfer.

Some mechanisms have been designed to supply torque through the primary arm rotation in a Pope-type reel, such as shown and described in German document DE 40 07 329 A1. However, this apparatus is complicated, costly and might do more harm than good to the paper sheet being wound into a roll. Thus, in the German document apparatus, an expensive and complicated servo system positions the drive and reducer assembly relative to the winding core. The use of complicated sensors and hydraulic systems increase installation and maintenance costs. Failure of any component in the feedback loop could be hazardous to personnel, equipment and roll structure. Further, on conventional winding machines, the roll may require a 400 HP drive motor at one end of the reel spool. Over-hung weights approaching 12,000-13,000 pounds can be expected. This results in cross-machine nip pressure variants and spool deflection which cannot be avoided. In this regard, spool deflection alone can create sheet defects near the reel spool/core.

Summary Of The Invention

This invention improves upon the winding procedure in a Pope-type reel. This invention also substantially eliminates or minimizes the undesirable and deleterious aspects associated with insufficient wound-in tension of the paper sheet around the reel spool during the early stages of the reeling process when the wound paper roll is relatively small in diameter.

In this invention, two different torque drives are applied to the reel spool, or core, during the reeling process. A unique pivoting platform, or primary drive stand, is mounted at one end of the apparatus to engage a reel spool soon after the reel spool is initially received by the primary reel arms and brought into proximity to the support drum to begin reeling the on-coming paper web into a roll of paper. The primary drive stand is mounted to rotate co-axially with the reel's support drum and primary arms. It is linked with a motor for driving a shaft which is connected to the new reel spool through a flexible coupling. This permits torque to be applied to the reel spool prior to the web winding process when the new reel spool is held by the primary arms and accelerated to web speed at a location spaced above the upper surface of the support drum. The drive remains engaged to the spool while bringing it in nipping contact with the drum, insuring proper speed match between the spool and drum. The traveling paper web is thereby wound with the desired tension onto the new reel spool, and the primary arms subsequently rotate the reel spool over the upper periphery of the support drum and, at some point, bring the reel spool with the initial wraps of paper web on it into nipping engagement with the support drum. The reel spool with the initial stages of the wound paper web on it then continues to be pivoted downwardly over the surface of the support drum while torque is continuously applied by the driven

coupling which pivots to follow the reel spool in its path over the support drum. At all times during this arcuate path of travel over the support drum, torque is applied to the reel spool/core to wind the paper web with a desired tension.

When the reel spool reaches the substantially horizontally disposed guide rails, the driven shaft on the primary drive stand is disengaged from the reel spool through its flexible coupling, and a secondary drive engages the reel spool to continue to supply torque to the paper roll as it is being wound. The paper roll continues to be engaged with the support drum along a nip line of contact therebetween, and the secondary drive follows the path of the wound paper roll as it moves radially outwardly from the support drum along the guide rails.

This invention, therefore, provides torque to the reel spool from the time when the traveling paper initially contacts the newly positioned reel spool in the primary arms until the paper roll is wound to the desired diameter on the guide rails. The wound-in tension in the paper sheet is, therefore, controlled at all times during the reeling process.

In addition, nip pressure of the paper roll being wound during the period when it is supported on the surface of the support drum is controlled through two cylinders mounted in opposed array in each of the primary arms. One cylinder maintains the desired nip pressure level between the developing wound paper roll and the support drum. The second cylinder, commonly termed the nip-relieving cylinder, is activated when the weight of the wound roll is excessive to provide the desired nip. At increased weights, it relieves the reel spool/core weight to maintain the desired nip pressure during its arcuate path of travel while supported over an upper

arcuate segment of the support drum surface. Such nip pressure control is optional as desired or required.

In this manner, both the torque and the nip applied to the reel spool, and the newly formed paper roll being wound on it, are controlled from the very beginning of the paper winding process.

Accordingly, it is an object of this invention to provide a Pope-type papermaking machine reel capable of reeling a wound roll of paper having the desired roll hardness without requiring excessive nip at the beginning of the paper web winding process.

Another object of this invention is to provide an improved Pope-type papermaking machine reel which improves the amount of saleable paper in a wound paper roll produced by the reel.

Another object, feature and advantage of this invention is the provision of a Pope-type papermaking machine reel wherein torque is applied to the reel spool from the beginning of the paper web reeling process.

Yet another object, feature and advantage of this invention is to provide a Pope-type papermaking machine reel having two drive mechanisms which are separately used to drive the reel spool during the entire paper web reeling process.

Yet another object of this invention is to provide a papermaking machine reel which produces a wound paper roll having reduced defects near the wound roll core.

These, and other objects, features and advantages of this invention will become readily apparent to those skilled in the art upon reading the description of the preferred embodiment in conjunction with the drawings.

Brief Description Of The Drawings

Figure 1 is a front-elevational view showing a Pope-type reel with the core-driving primary drive apparatus at the left, on the front of the machine, and the core-driving secondary drive apparatus on the right, at the back of the machine.

Figure 2 is a more detailed front-elevational view of the primary drive apparatus for applying torque to the reel spool.

Figure 3 is a side-elevational view of a Pope-type papermaking machine reel showing the primary arms and a reel spool in both its initial position, while held by the primary arms, and its subsequent position when it is supported on the horizontal guide rails. This view is somewhat schematic in form in that it does not show the web turn-up apparatus for guiding the web onto a new reel spool, nor does it show the secondary reel arms.

Figure 4 is a side-elevational view of a Pope-type reel showing the secondary arms for engaging the reel spool as the web is wound thereon when the roll is supported on the guide rails.

Description Of The Preferred Embodiment

With reference to Figure 2, a support stand **10** is mounted on the floor at the front side of the reel, which is generally designated with the

numeral **12**, on a papermaking machine. A platform **14** is mounted on the support stand with a plurality of bearings **16** so as to be pivotable about an axis **18** which is co-axial with the axis **20** of the support drum **22** in the reel. A motor **24** is mounted on the support stand with the axis **26** of its drive sheave **28** also co-axial with the axis **18** of rotation of the platform **14**. The platform thus rotates about its aligned axes **18** on either end thereof about corresponding arms **30**.

On the upper side of the platform **14** near one end is an in-shaft drive system comprising a drive sheave **32** mounted on a shaft **34** which is rotatably supported in bearings **36**. The sheave **32** of the in-shaft drive system is aligned with the sheave **28** on the motor drive shaft, and the motor is thus connected to the in-shaft drive system by a timing belt **38**.

Near the other end of the support stand closest the reel, and spaced from the in-shaft drive system, is a coupling apparatus, generally designated with the numeral **40**, which is connected with the in-shaft drive system via a shaft **41**.

The coupling apparatus **40** includes a female coupling half **42** and a male coupling half **44**. The female coupling half is connected to a cam clutch **46** which, in turn, is actuated by a rod-less pneumatic cylinder **48** which extends between a pair of mounting plates **50** which are held together by bolted cross members **52**. The rod-less cylinders also relieve the overhung weight of the shaft and coupling assembly. Linear bearings **54** permit reciprocal movement of the flexible coupling, by positioning cylinder **55**, on which the female coupling half is mounted into, and out of engagement with the male coupling half which is attached to the reel spool, or core, **56**.

As shown in Figure 1, a secondary drive, generally designated by the numeral **58**, is mounted on a secondary support stand **60**. It is positioned so that its coupling **62** will permit the secondary drive motor **64** operating through drive belt **66** in much the same manner as described previously in conjunction with the primary drive apparatus, to engage the front end of a reel spool when the reel spool with a partially wound paper roll is supported on a pair of spaced, parallel, horizontally disposed guide rails **68,68'**.

The secondary drive apparatus is mounted on a pair of guide bars **70,70'** which support the secondary drive apparatus for lateral movement parallel to the path of the axis **72** of the reel spool **56** as the reel spool rolls along the guide rails **68,68'**.

With reference to Figure 3, a Pope-type papermaking machine reel **12** is shown with a pair of primary arms **13,13'** in which a reel spool **56** is held in an initial position slightly spaced above the support drum **22** when the reel spool is initially loaded into a rotatably mounted position in the primary arms.

Although two reel spools are not operationally utilized in the reel apparatus at the same time, a reel spool **56'** is also shown in its position supported on rails **68,68'** to illustrate the position when the new reel spool mounted in the primary arms eventually is positioned. The reel support drum **22** is rotatably powered by a separate motor shown schematically at **23**.

With reference to Figure 2, within each of the primary arms **13,13'**, a pair of opposed cylinders **8,9** are mounted to provide nipping pressure force, via cylinder **8**, or nip-relieving pressure force, via cylinder **9**. This permits the reel spool, or core, **56**, which is rotatably clamped between

upper and lower blocks **6,7** in the primary arms (Figure 3) to be moved to nip the reel spool into nipping engagement with support drum as the primary arms rotate downwardly in the direction of arrow **74** as the new reel spool grows larger while the on-coming paper web is wrapped upon it.

The construction and operation of the Pope-type reel itself, as well as the secondary drive for applying torque drive to the wound paper roll supported on the guide rails, is known in the papermaking industry, so they will not be discussed in further detail except in conjunction with the construction and operation of the primary drive. Thus, the apparatus of the known Pope-type reel shown in Figure 4, which shows the web turn-up apparatus **75** and secondary arm apparatus **76**, which form no part of this invention, will not be discussed in further detail.

In operation, a new reel spool/core **56** is received in the upper and low core blocks **6,7** of the primary arms **13,13'**. A traveling on-coming paper web **W** is guided by web turn-up apparatus to be received onto the new reel spool, and the flexible coupling **40** is actuated by the positioning cylinder **55** to connected the shaft **41** with the new reel spool. Motor **24** drives the in-shaft **41** via the timing belt **38** through sheaves **28,32** to accelerate the new spool to web speed and to provide driving torque to the new reel spool while winding the beginning portion of the traveling web onto the reel spool at the desired tension.

When the web has been transferred to the new spool via the turn-up apparatus **74**, the primary arms begin their rotation in the direction of arrow **74** toward the support rails **68,68'**. The newly formed wound web roll is both torqued and nipped to produce the desired roll structure. Since the axis of the platform drive motor is co-axial with the rotational axis of the support drum, and since the platform also rotates co-axially with the

primary arms, the flexible coupling **40** can follow the rotation of the reel spool continuously as it moves downwardly toward the support rails. During this rotational movement of the primary arms, the outwardly radial movement of the reel spool as the wound paper web builds up on its is accommodated by pivotal movement of shaft **41** in its coupling **43**, as well as axial movement of the outer portion of the shaft about a splined portion **45** of the shaft attached to the coupling **43**.

At some point during this arcuate movement of the primary arms, depending on the weight of the built-up paper roll and the desired nip pressure of the wound paper roll against the support drum, the relieving cylinder **9** is activated to relieve the weight of the wound paper roll beyond a certain, predetermined desired limit, so as to maintain the nip pressure of the wound paper roll against the support drum at a desired level due to its weight.

When the primary arms have brought the relatively small diameter, newly formed wound web roll onto the support rails to be supported thereon while maintaining nipping engagement with the support drum, the primary drive on the front side of the roll is deactuated by the positioning cylinder **55**, and the secondary drive **58** is actuated to engage the front side end of the reel spool to continue providing driving power and torque to the paper roll as it continues to be wound while engaged in nipping contact with the support drum via the secondary arms while the wound web roll is supported vertically on the substantially horizontally arrayed guide rails **68,68'**.

The newly formed wound paper roll is thereby wound under continuous driving torque from the time the on-coming paper web is introduced onto the newly received core in the primary arms until the

wound paper roll reaches a desired diameter while it is supported on the substantially horizontally disposed guide rails in the reel. In addition, the nip between the paper roll as it is being wound is controlled during the early stages of the winding process by operation of the pressure cylinders **8,9** in the primary arms.

Since the weight of the platform is supported by the support stand through its bearings, there is very little over-hung weight on the reel spool from the time it is received in the primary arms until it is deposited on the supporting guide rails. Then, since the weight of the wound paper roll is supported on the guide rails while the secondary drive is engaged, the over-hung weight on the reel spool and paper roll being wound thereon is also very small since the secondary drive is also supported on its own guide system for lateral movement parallel to the path of travel of the building paper roll supported on the guide rails.

Accordingly, an improved Pope-type reel drive system, which meets the objectives and incorporates the features and advantages of this invention, has been disclosed. Naturally, minor changes in the structure and operation of the invention can be made by the skilled artisan without departing from the spirit and scope of the appended claims.

WHAT IS CLAIMED IS:

1. Apparatus for reeling a substantially continuous traveling web onto a reel spool to produce a wound web roll, comprising, in combination:

a support drum (22), having a longitudinal axis of rotation (20), for engaging the reel spool (56), on which the web (W) is directed to be wound thereon, along a nip line of contact therewith;

support drum drive means (23) for rotatably driving the support drum;

a support drum stand (10) for rotatably mounting the support drum (22), the support drum stand including a pair of spaced, horizontally disposed guide rails (68,68') for supporting the reel spool (56), on which the traveling web is being wound, radially relative to the support drum;

a pair of primary arms (13,13') pivotally mounted co-axially about the support drum (22) for rotatably mounting a reel spool (56) for peripheral movement about an arcuate portion of the support drum surface to deliver the web roll being wound to a predetermined location in the apparatus;

primary support stand means, including a primary drive stand (14) disposed near one end of the support drum, and mounted to pivot co-axially therewith;

a primary power means (24,28,38) mounted in the primary support stand means for rotatably driving the reel spool (56) while the reel spool is mounted in the primary arms;

power transmission means (32,34,43,41,40) linked with the primary power means for rotatably and selectively engaging, and disengaging, the reel spool on which the traveling web is introduced to commence the web winding process thereon, said power transmission means operable to engage the reel

spool continuously as the primary drive stand pivots with the primary arms about the upper periphery of the support drum.

2. Apparatus for reeling a traveling web onto a reel spool to produce a wound web roll as set forth in claim 1, wherein:

the primary support stand means (14) is disposed on the front side of the apparatus, and further including:

secondary support stand means (60) disposed on the back side of the apparatus, and including a secondary power means (58) mounted in the secondary support means for rotatably driving the reel spool when the reel spool has been delivered to the predetermined location in the apparatus.

3. Apparatus for reeling a traveling web onto a reel spool to produce a wound web roll as set forth in claim 1, wherein:

each of the primary arms (13,13') contains reel spool loading (8) and relieving (9) means for selectively loading and relieving the nip pressure of the web roll being wound against the support drum during at least a portion of the travel of the reel spool arcuately about the support drum.

4. Apparatus for reeling a traveling web onto a reel spool to produce a wound web roll as set forth in claim 3, wherein:

the reel spool loading and relieving means comprises opposed loading and relieving cylinders (8,9) for selectively loading and relieving the reel spool against the support drum.

5. Apparatus for reeling a traveling web onto a reel spool to produce a wound web roll, said apparatus substantially as shown and described in the specification and drawings.

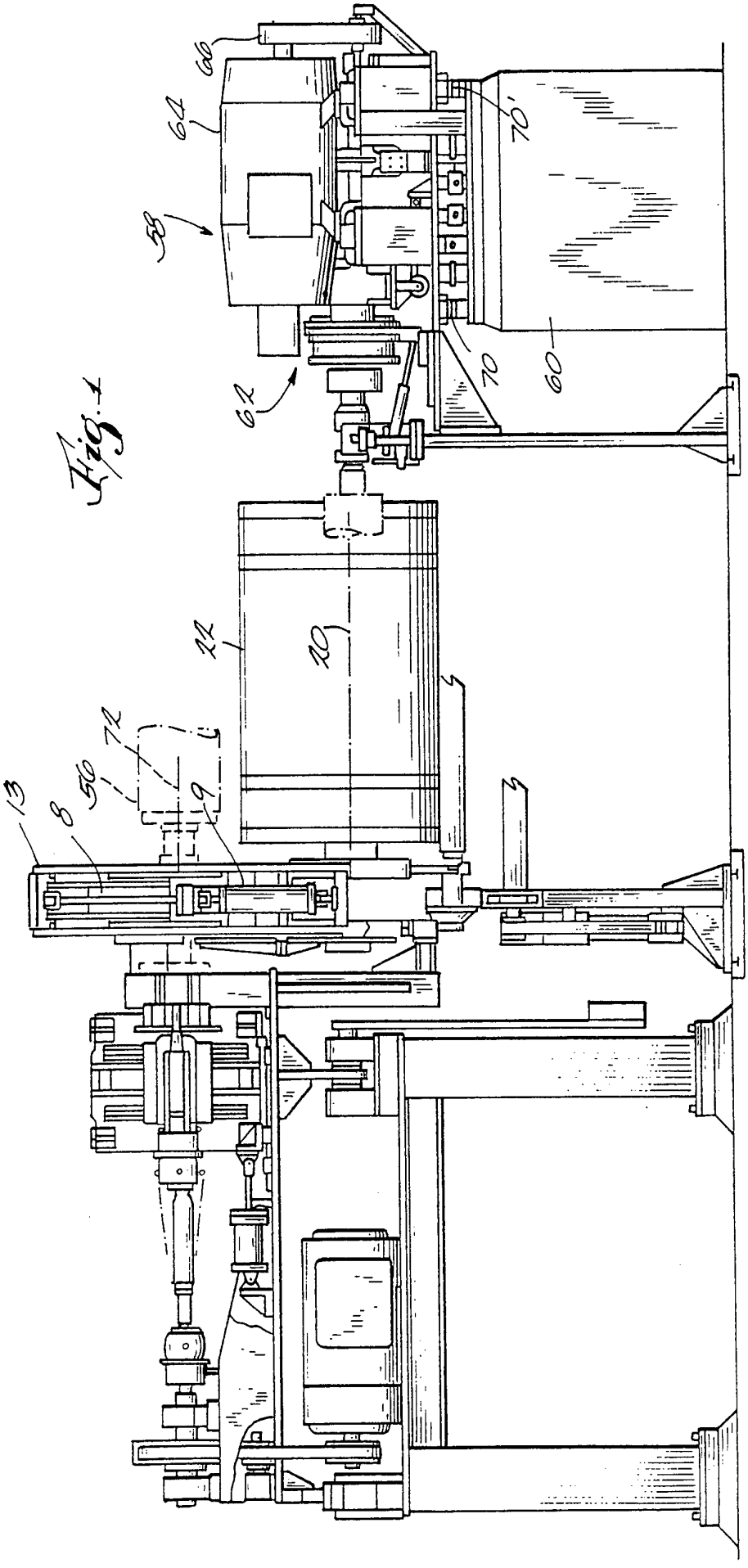


Fig. 1

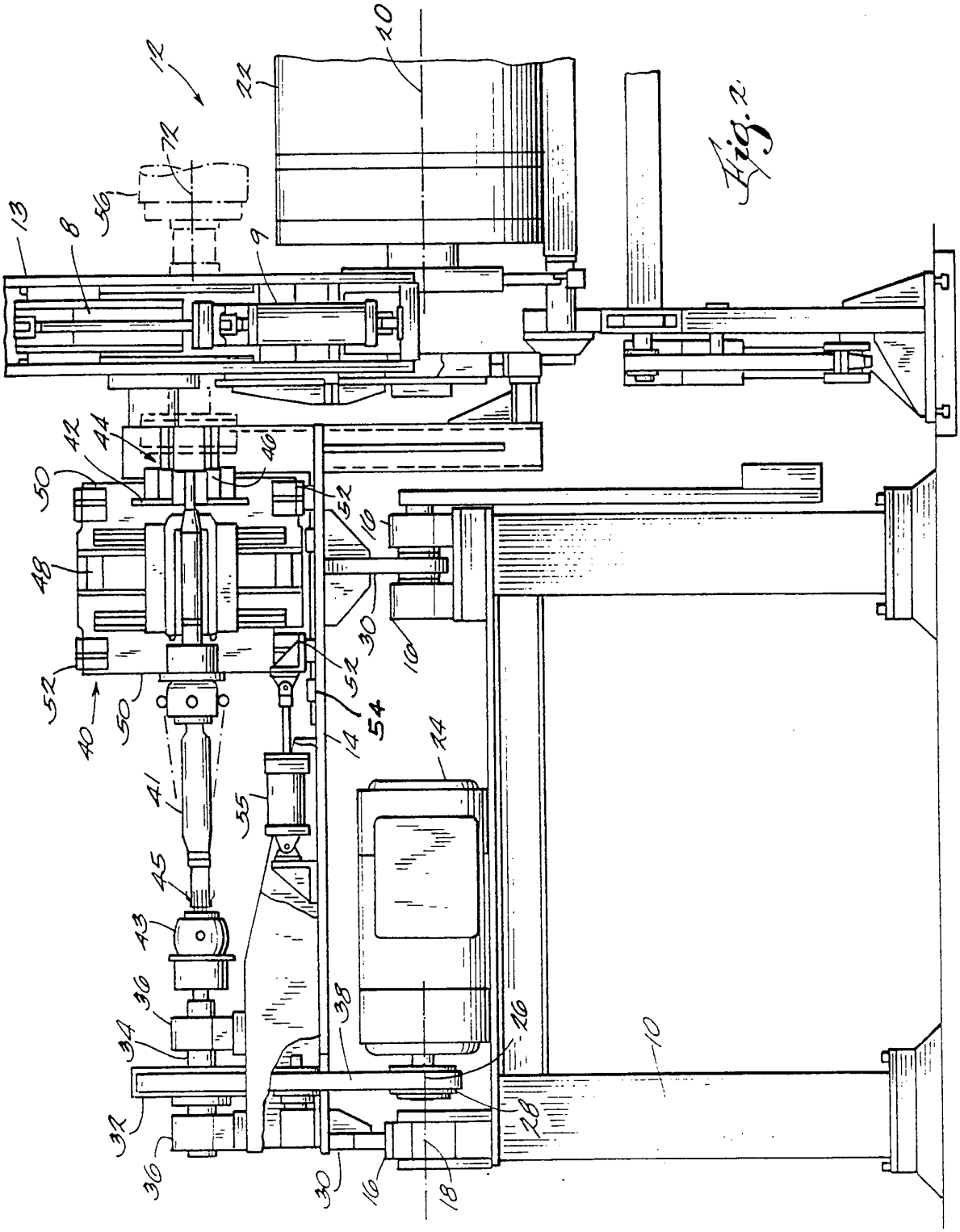

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Fig. 2.

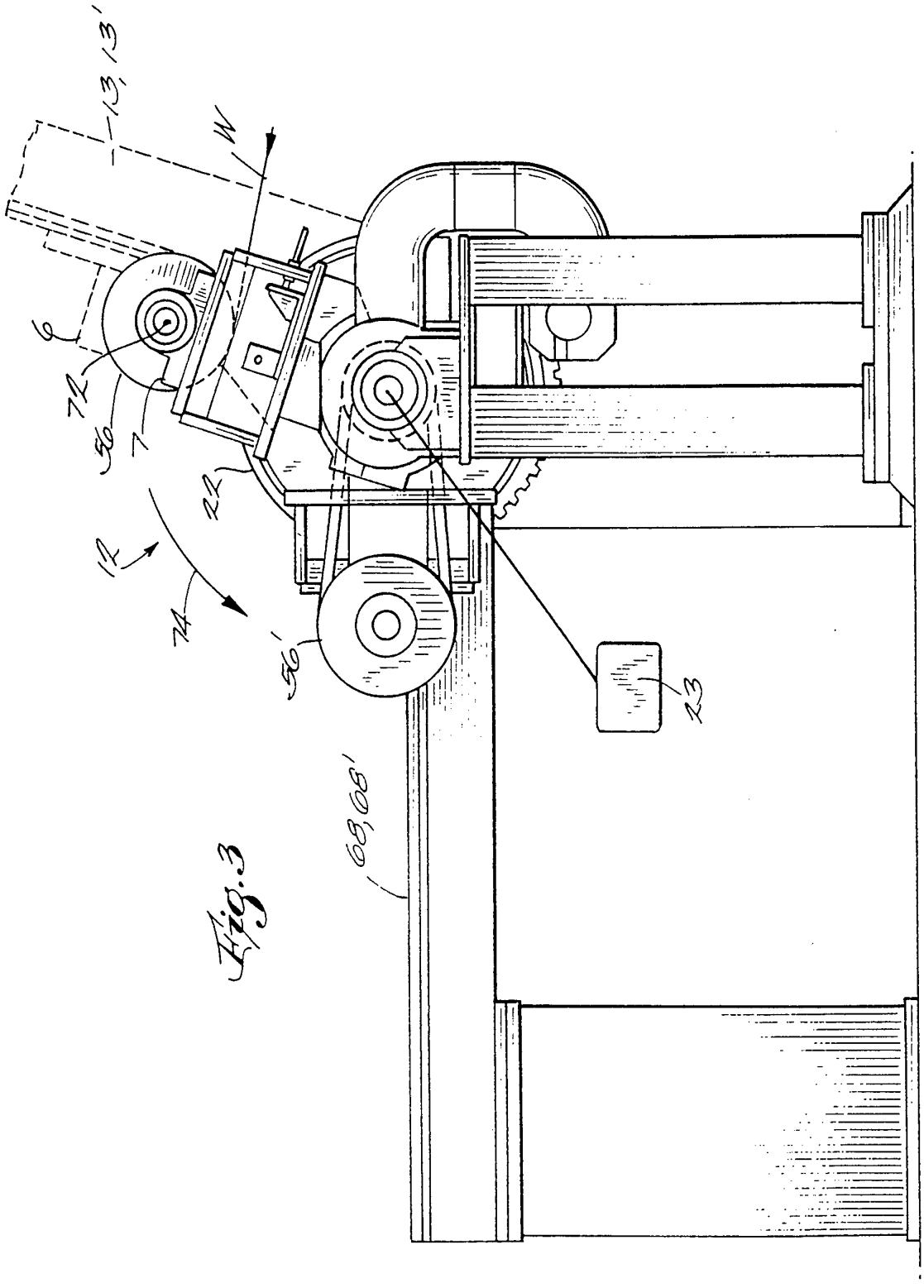


Fig. 3

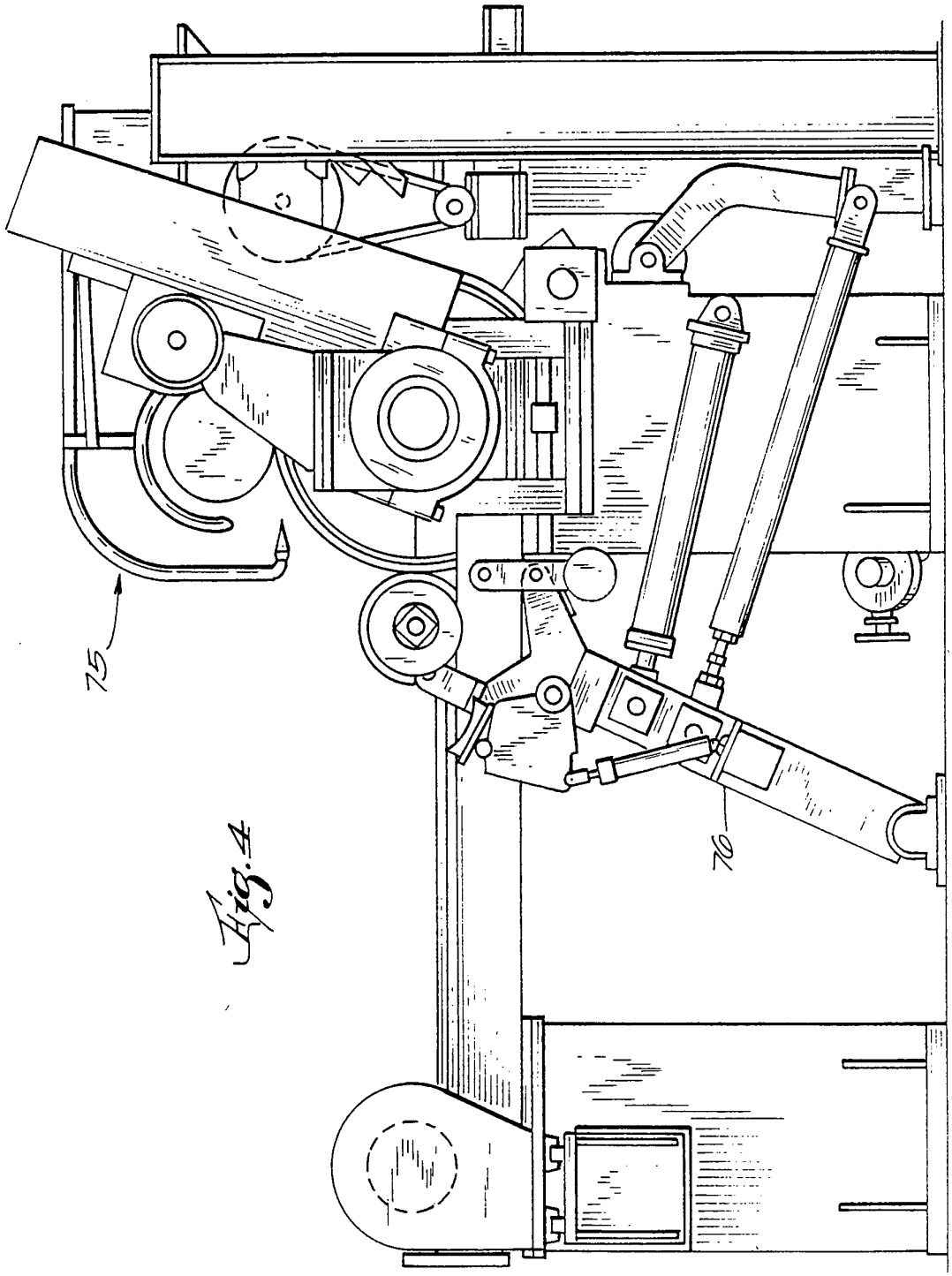


Fig. 4

INTERNATIONAL SEARCH REPORT

Internatio[n] Application No
PCT/US 94/01174

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 B65H19/22 B65H18/26

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)
IPC 5 B65H

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 practical, 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.
X	DE,A,40 07 329 (J.M. VOITH GMBH) 12 September 1991 cited in the application see claims 1,3,5,6,8; figures 1-8 see page 2, line 16 - line 30 see page 2, line 39 - line 45 see page 2, line 53 - line 62 see page 2, line 68 - page 3, line 31	1-5
A	US,A,3 202 374 (R.W. PHELPS) 24 August 1965 see figures 1-3 see column 2, line 48 - column 5, line 2 see column 5, line 30 - column 6, line 39	1,3

☐ Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search	Date of mailing of the international search report
30 May 1994	20. 06. 94

Name and mailing address of the ISA	Authorized officer
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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A-4007329	12-09-91	US-A- 5184787	09-02-93
US-A-3202374		NONE	