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(54) **Apparatus for detecting mutual positions and controlling travelling of a plurality of working components sequentially mobile along parallel straightline paths**

(57) An apparatus for detecting mutual positions and controlling travelling of a plurality of working components (2, 3, 4) sequentially mobile along parallel straight-line paths (6), the apparatus comprising an electronic control unit (20), differential drive means (19; 26, 27, 28) for the said working components (2, 3, 4) and a transducer (21) arranged to detect the position of

each working component (2, 3, 4) and to generate output signals indicating the position of each working component for the control unit (20), whereby the control unit will generate control output signals for the drive means (19; 26, 27, 28) for the relative differential movement of the working components (2, 3, 4).

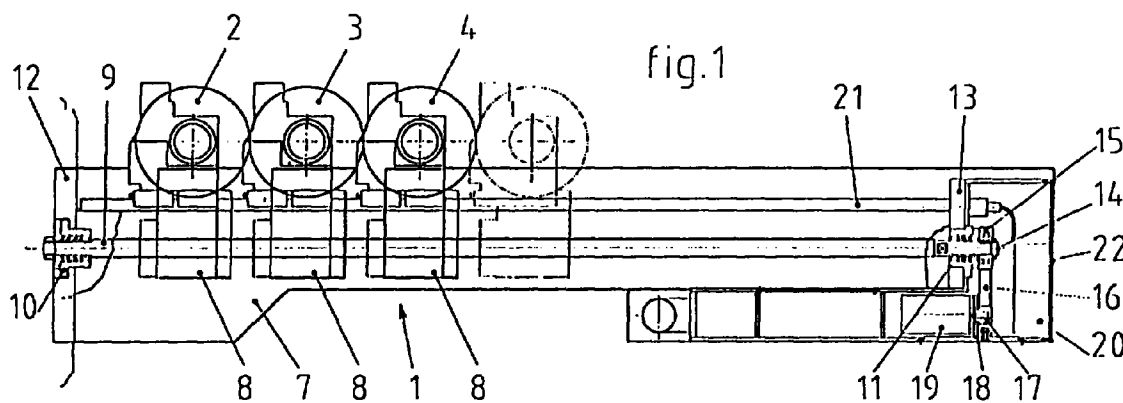


fig.1

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Description

The present invention relates to an apparatus for detecting mutual positions and controlling travelling of a plurality of working components sequentially mobile along parallel straight-line paths.

A typical, although not exclusive, application of the present invention is the driving motion of the cylinders in a printing or rolling group that conventionally requires the use of complex and expensive mechanical transmission systems which are subject to inevitable plays and inaccuracies.

The main object of the present invention is to provide an apparatus for detecting mutual positions and controlling travelling of three or more working components sequentially mobile along parallel straight-line paths, whereby making it possible either to move all the mobile working components in unison or to displace only one or some of them independently of the others.

Another object of the present invention is to provide a detecting and controlling apparatus arranged to cause a plurality of mobile elements to effect motions of translation with high accuracy, e. g. of the order of 2 microns, by using either one motion source or a motor for each mobile element.

A further object of the present invention is to provide a detecting and controlling apparatus which is highly reliable and has low operating costs.

These and still further objects that will appear better hereinafter are attained by an apparatus for detecting mutual positions and controlling travelling of a plurality of working components sequentially mobile along parallel straight-line paths, characterized in that it comprises an electronic control unit, a differential drive means for the working components and a transducer arranged to detect the position of each working component and to generate output signals indicating the position of each working component for the control unit, whereby the control unit will generate control output signals for the drive means for the relative differential movement of the working components.

Advantageously, the linear transducer comprises an absolute transducer comprising a magnetostrictive bar detecting device with an electronic interface.

Further aspects and advantages of the present invention will be apparent in the following detailed description of some presently preferred embodiments illustrated by way of not limiting examples in the accompanying drawings, in which:

Figure 1 is a diagrammatic side elevation view of a printing group of a multi-colour printing machine with simultaneously motor-driven cylinders;

Figure 2 is a cross-sectional view taken along the line II-II of Fig. 1;

Figure 3 shows a top view of half the printing group of Fig. 1;

Figure 4 is a diagrammatic side elevational view of a printing group in a multi-colour printing machine with cylinders provided with a respective motor;

Figure 5 shows a cross-section view taken along the line V-V of Fig. 4; and

Figure 6 shows a top view of half printing group of Fig. 4.

In the accompanying drawings the same parts or components are indicated with the same reference numerals.

With reference first to Figures 1 to 3 the detecting and controlling apparatus according to the present invention is applied to a printing group 1 of a flexographic machine or of a rolling plant for spreading adhesives, paints or lakes. The apparatus comprises three or more cylinders, and in the case of a flexographic, are referred to as back-holding roller 2, screen cylinder 3 and drawing cylinder 4. However, for the rolling machines the same cylinders are differently termed in the art.

Cylinders 2 to 4 are rotatably mounted at their end holds 2a, 3a and 4a, respectively, on a respective pair of lateral shoulders 5 which are in turn slidably supported, i.e. they can translate on straight-line guides 6 carried by a pair of cantilevered brackets 7, whereby the lateral shoulders act as slides. Each lateral shoulder 5 has also a downward extension 8, which is offset with respect to its respective bracket 7 and locates a lead nut (not shown in the drawings and of the type disclosed in our patent application VR97A000021, filed on March 11, 1997 and relating to a control device for controlling movements of a plurality of sequential elements movable along parallel straight-line paths) in a screwing engagement with a ball-cycling screw 9 which is laterally supported on each bracket 7, e. g. the ball-cycling screw 9 can be supported at its ends on ball bearings 10 and 11 seated into lugs 12 and 13, respectively, of each bracket 7.

One end of the ball-cycling screw 9 has a tang 14 on which a toothed pulley 15 is fitted. A toothed transmission belt 16 is wound around both pulley 5 and a driving pulley 17 which is fitted on the output shaft 18 of a geared motor group (comprising a step motor and epicyclical reduction gear) 19 controlled by an electronic control unit or card 20.

Parallel to and co-extensive with the ball-cycling screw 9 (e.g. slightly above the same) there is a bar sensor 21 which extends along one side of each bracket 7. An example for a bar sensor may be an absolute magnetostrictive linear movements transducer of any suitable type, such as a Tempsonic sensor manufac-

tured by MTS Systems Corporation - North Carolina - USA, which is an absolute sensing device arranged to detect the relative position of each slide 5, and thus of the cylinder carried by it and to feed input signals to the control unit 20.

Preferably, the geared motor group 19, the control unit 20 and the transmission of the motion from the geared motor group 19 and the ball-cycling screw 9 are located in an explosion-proof box 22, as required by the law in many countries.

With the above-described structure it is possible to obtain a diversified movement of the cylinders 2, 3 and 4. As a matter of fact, sensor 21 feeds input signals representative of the position of each cylinder 2 to 4 to the control unit 20. The control unit can keep in operation all the lead nuts within the lugs 8, and thus by sending a control signal to the step motor of the geared motor group 19 the cylinders 2 to 4 all move in unison. Alternatively, the control unit 20 can disengage all the lead nuts and keep in operation only the lead nut of the first cylinder, and thus upon energising the geared motor group 19 only the first cylinder will be moved, or the last two cylinders and so on, and this can be obtained with an accuracy of about 2 microns, which is amply sufficient for any printing or rolling operation.

Parallel to the ball cycling screws 9 on the brackets 7 there is also supported a splined shaft 23, e. g. a three-lobed ball shaft, which is operatively connected to a gear reduction unit 24 for each cylinder 2 to 4 for transmitting rotational motion to its respective cylinder. Shaft 23 is head driven by an electric motor 25 of suitable power, and thus the speed of the cylinders 2 to 4 depends upon that of the motor 25 which, however, remains stationary in position and does not move with the cylinders. Since the splined shaft 23 allows the cylinders 2 to 4 both to rotate and translate, it is possible to move the cylinders relative one another even when the same are rotating.

With the above-described device it is thus possible to automatically and accurately adjust the position of the cylinders along the brackets 7 with an extremely reduced and simplified mechanical structure.

In the embodiment shown in Figures 4 to 6 the various cylinders 2 to 4 have each a respective electric motor 26, 27 and 28 for causing them to rotate around their axis, each motor having a respective transmission group indicated at 29, 30 and 31, respectively.

The above described apparatus is susceptible to numerous modifications and variations within the scope as defined by the claims.

Thus, for example, a magnetostrictive bar sensor may be replaced by an absolute incremental optical line sensor or encoder.

Claims

1. An apparatus for detecting mutual positions and controlling travelling of a plurality of working compo-

nents (2, 3, 4) sequentially mobile along parallel straight-line paths (6), **characterized in that** it comprises an electronic control unit (20), differential drive means (19; 26, 27, 28) for said working components (2, 3, 4) and a transducer (21) arranged to detect the position of each said working component (2, 3, 4) and to generate output signals indicating the position of each working component for said control unit (20), whereby said control unit will generate control output signals for said drive means (19; 26, 27, 28) for the relative differential movement of said working components (2, 3, 4).

2. An apparatus as claimed in claim 1, **characterized in that** the said drive means (19; 26, 27, 28) comprises at least one ball-cycling screw (9) which is mounted for rotation with its axis substantially parallel to each of said straight-line paths (6), a step motor/gear reduction unit group (19) controlled by said control unit (20) and arranged to rotate its respective ball-cycling screw (9) and a lead nut seated in each working component (2, 3, 4) and being selectively engaged with its respective ball-cycling screw (9) by said control unit (20).
3. An apparatus as claimed in claim 1 or 2, **characterized in that** said transducer (21) is an absolute linear transducer comprising a magnetostrictive bar transducer with an electronic interface.
4. An apparatus as claimed in claim 1 or 2, **characterized in that** said transducer (21) comprises an optical line transducer.
5. An apparatus as claimed in claim 1 or 2, **characterized in that** said transducer (21) comprises at least an absolute or incremental encoder.
6. An apparatus as claimed in any preceding claim, **characterized in that** said work components (2, 3, 4) comprise a plurality of pairs of supports (5) each for a respective rotating working component (2, 3, 4), a transmission group for each rotating working component, at least one splined shaft (23) extending parallel to the or each straight-line paths (6) and operatively connected with each of said transmission groups (19), and one motion source for the or each splined shaft (23) for transmitting rotational motion to said rotating components (2, 3, 4).
7. An apparatus as claimed in any claim 1 to 5, **characterized in that** said working components (2, 3, 4) comprise a plurality of pairs of supports (5) for as many rotating working components (2, 3, 4) and a reduction gear unit (19) for each working component (2, 3, 4).

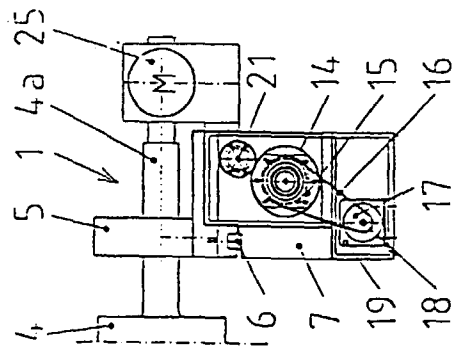


fig.1

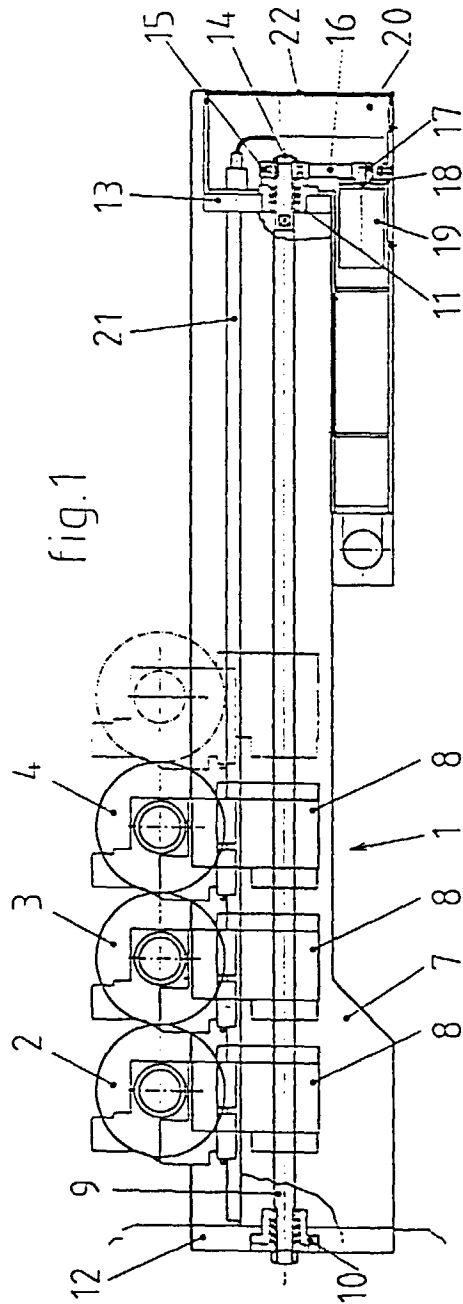


fig.2

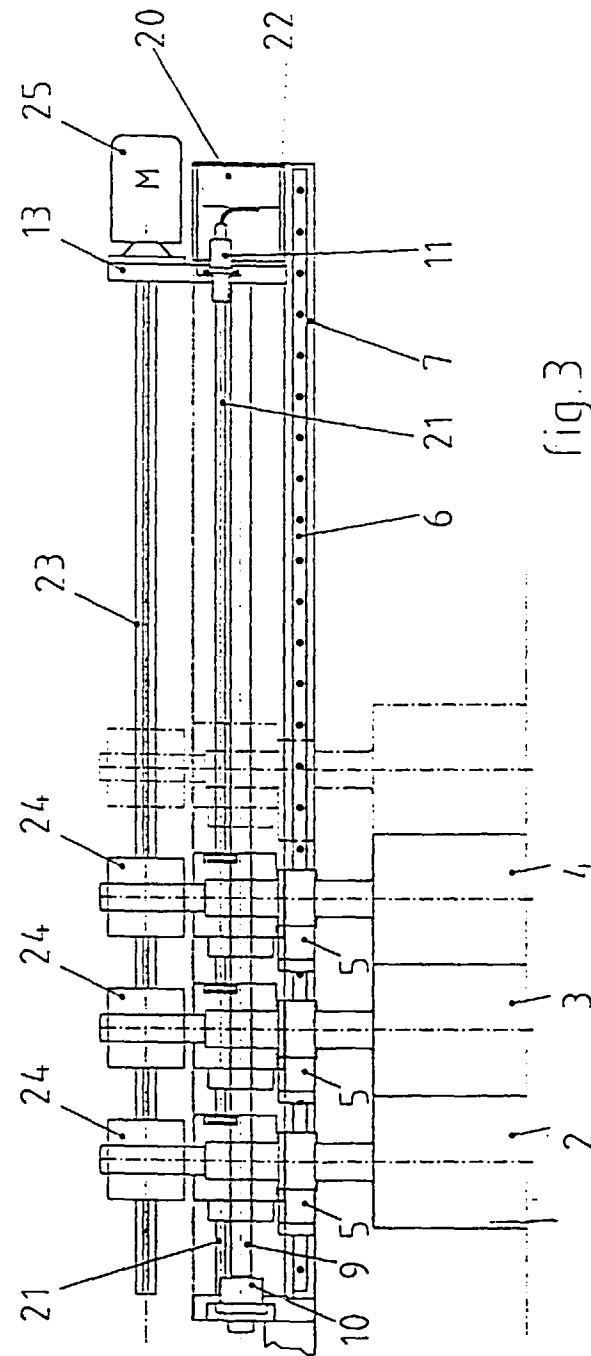


fig.3

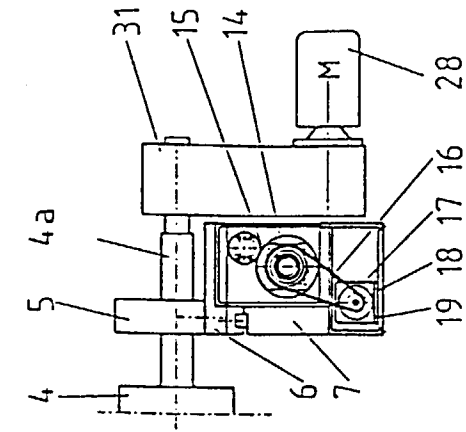


fig.5

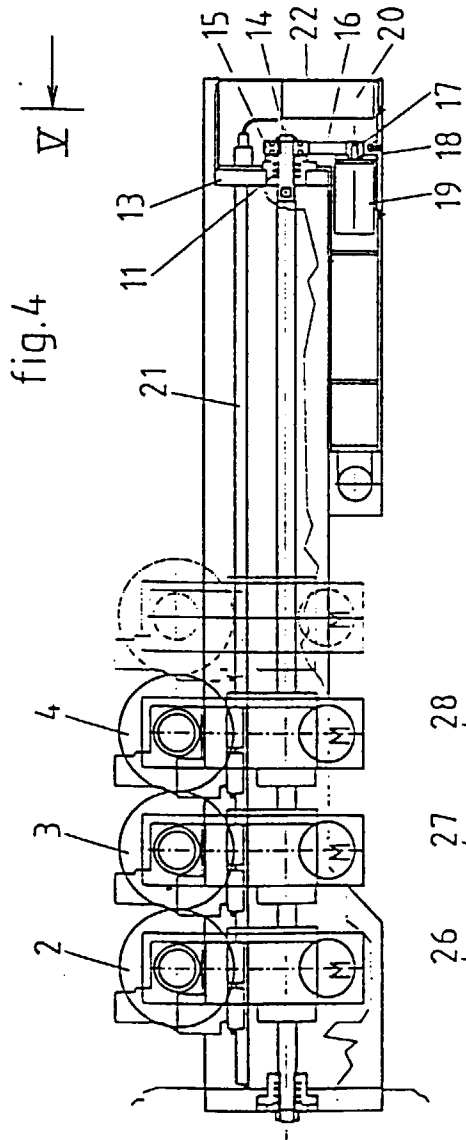


fig.4

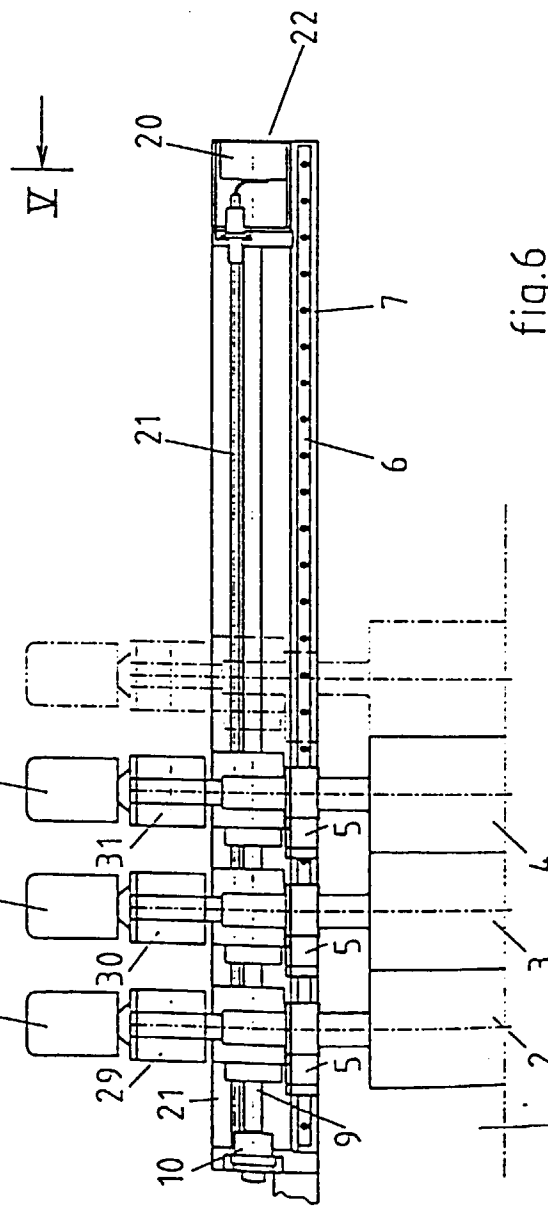


fig.6



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EUROPEAN SEARCH REPORT

Application Number
EP 98 10 6061

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.6)
X	EP 0 351 672 A (MASCHINENFABRIK SCHWEITER AG.) 24 January 1990 * column 4, line 14 - line 56; figures 1,2 *	1	B41F13/24 D21G1/00 B41F31/30
A	FR 2 224 592 A (KLEINWEFERS INDUSTRIE-COMPAGNIE GMBH) 31 October 1974		
A	EP 0 096 646 A (HOLWEG S.A.) 21 December 1983		
A	EP 0 557 198 A (KOMORI-CHAMBON SA.) 25 August 1993		
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B41F D21G
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 30 June 1998	Examiner DIAZ-MAROTO, V
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