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B65H 54/28

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(56) Documents Cited
EP 0462430 A US 5370325 A

(58) Field of Search
UK CL (Edition R) D1J
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Online : WPI, EPODOC, PAJ.

(54) Abstract Title
Yarn winding : traversing

(57) A yarn being wound on a package is traversed by a guide to which is applied a primary reciprocation and a superimposed secondary reciprocation to produce a linked harmonic traverse motion. The primary motion may be simple harmonic, and the secondary motion may comprise at least one harmonic of the primary. The dwell time at traverse turn around is thereby reduced to enhance package end stability. A yarn guide 18 and support 13 are traversed with a primary simple harmonic motion by successive energisation of coils 17, while cam groove 25 superimposes on follower 19 and guide 18 a secondary motion which is a combination of harmonics of the primary motion. Alternatively, support 13 may be traversed by a reversing endless band (Fig. 2, not shown), or by a rotating roller with an endless groove (Fig. 3, not shown). Many guides may be traversed simultaneously.

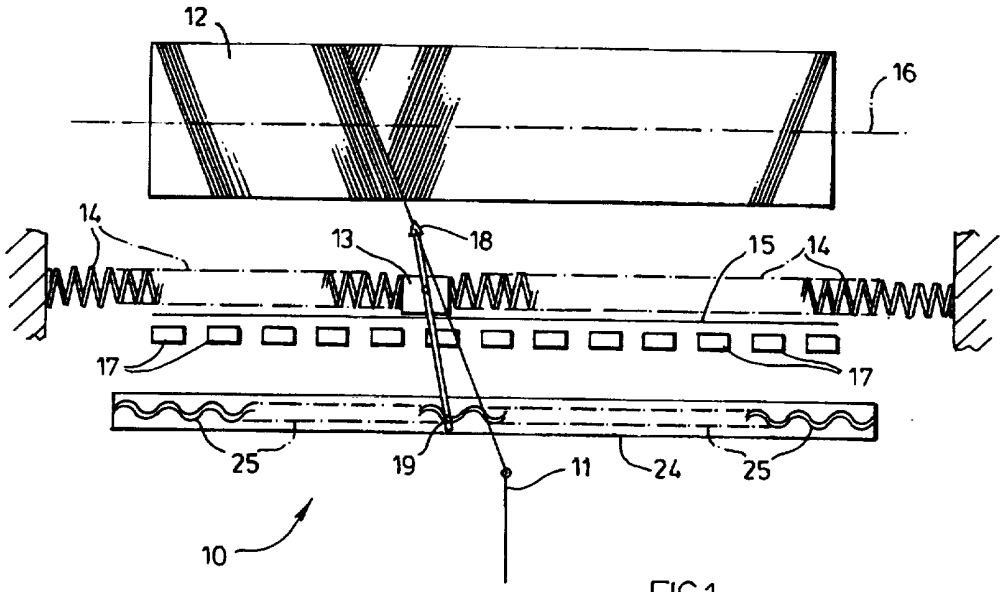

FIG.1

GB 2 345 300 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

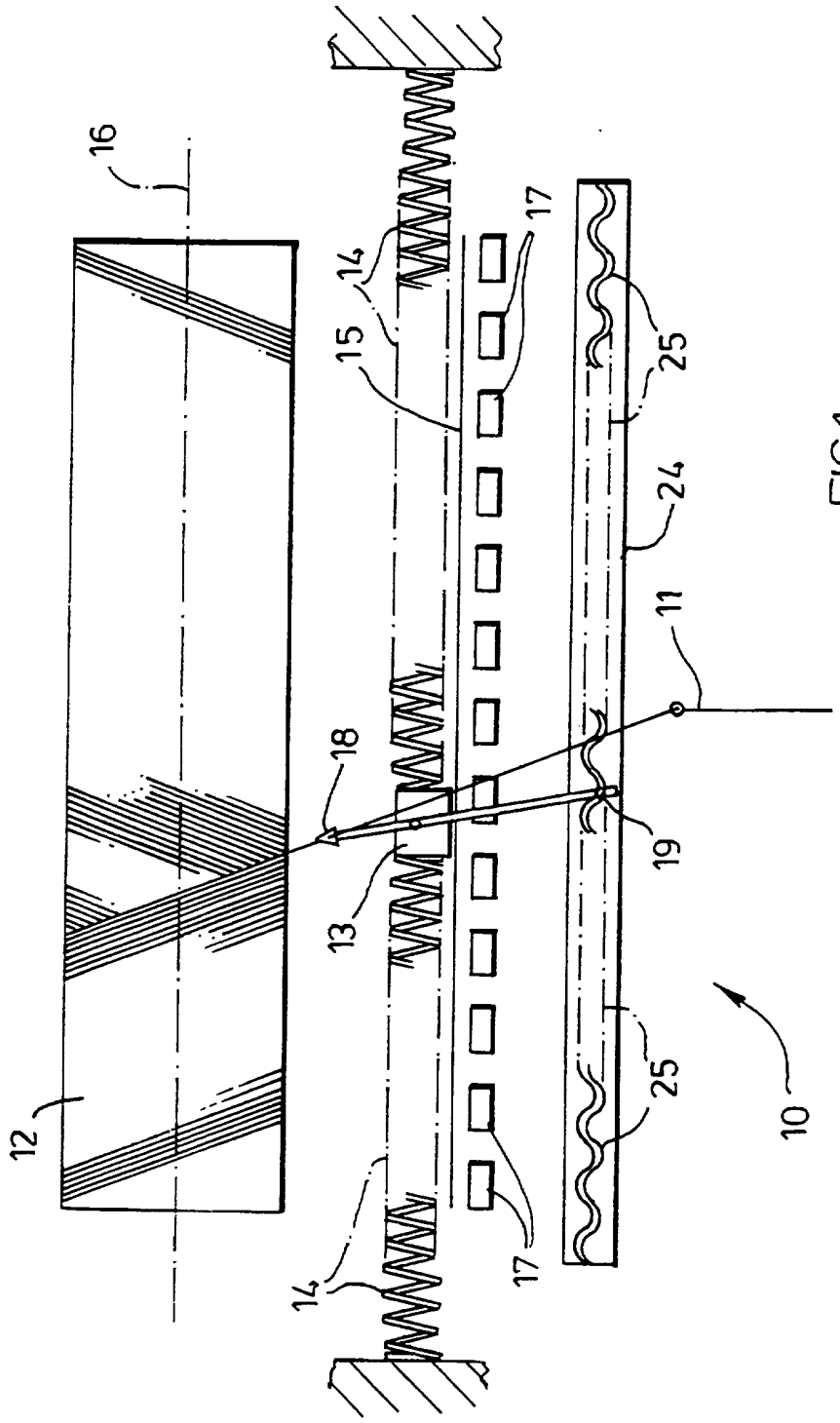

FIG.1

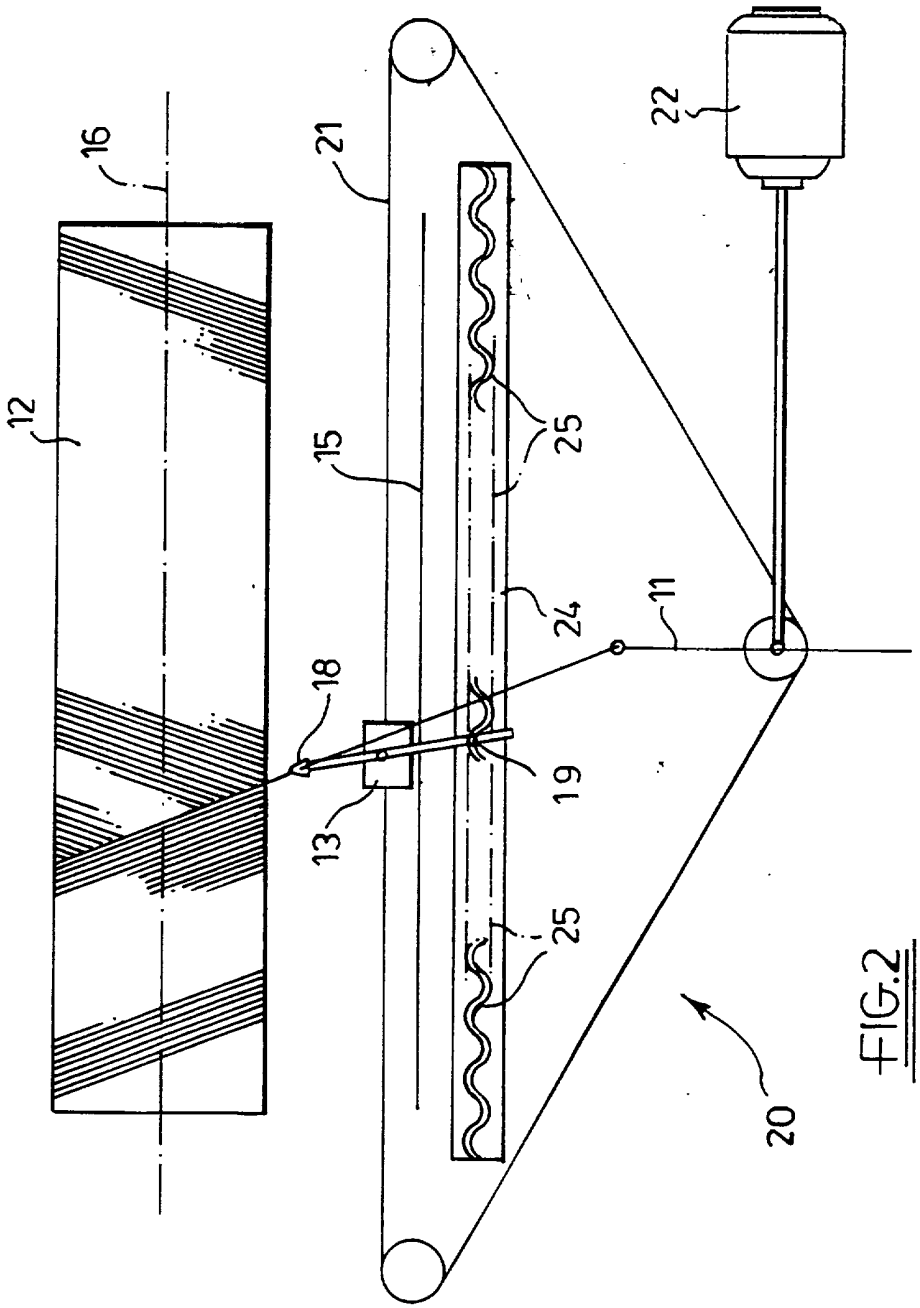

FIG.2

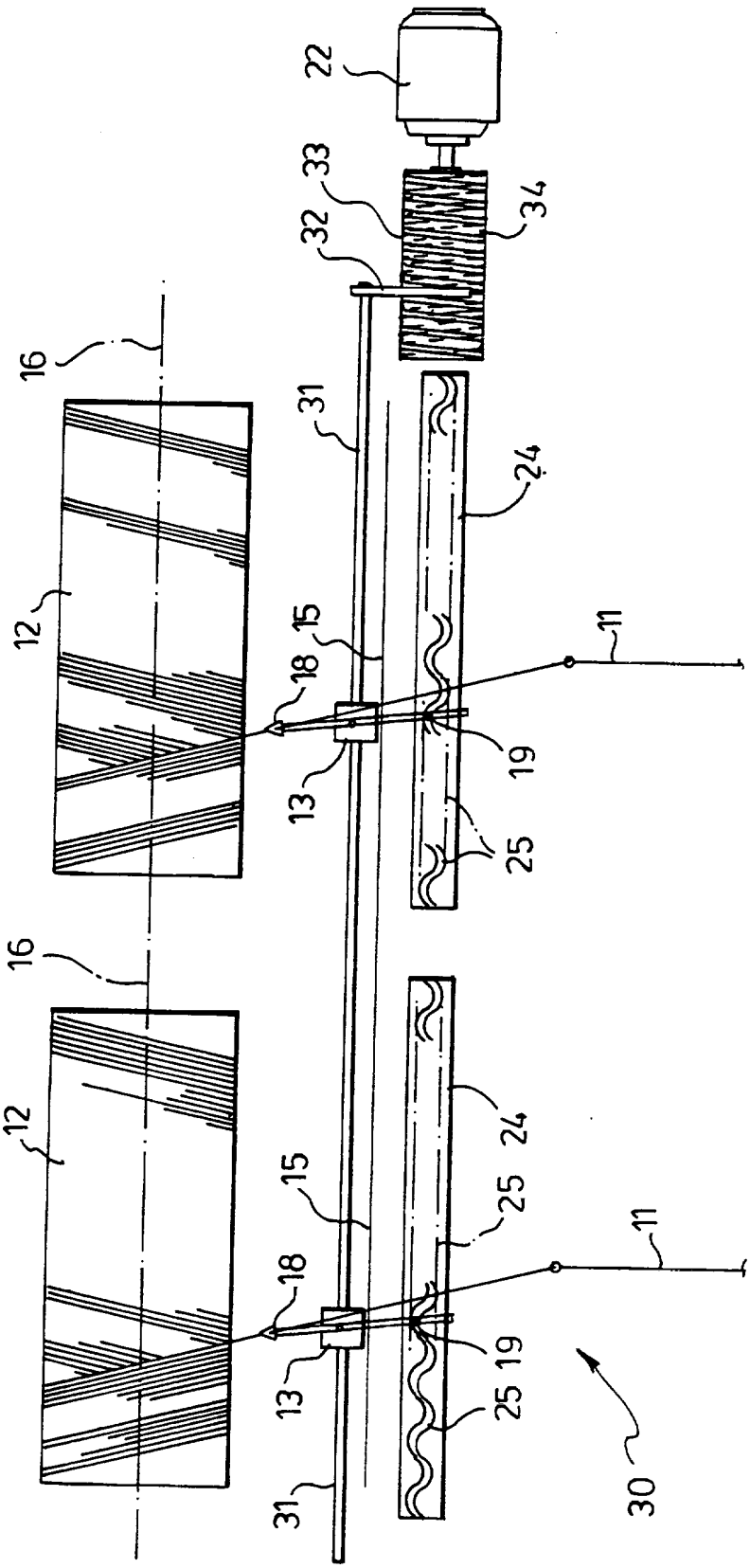
22
33
32
34
16
31
24
12
15
18
11
19
13
25
16
12
24
15
25
18
11
19
13
25
31
30

FIG.3

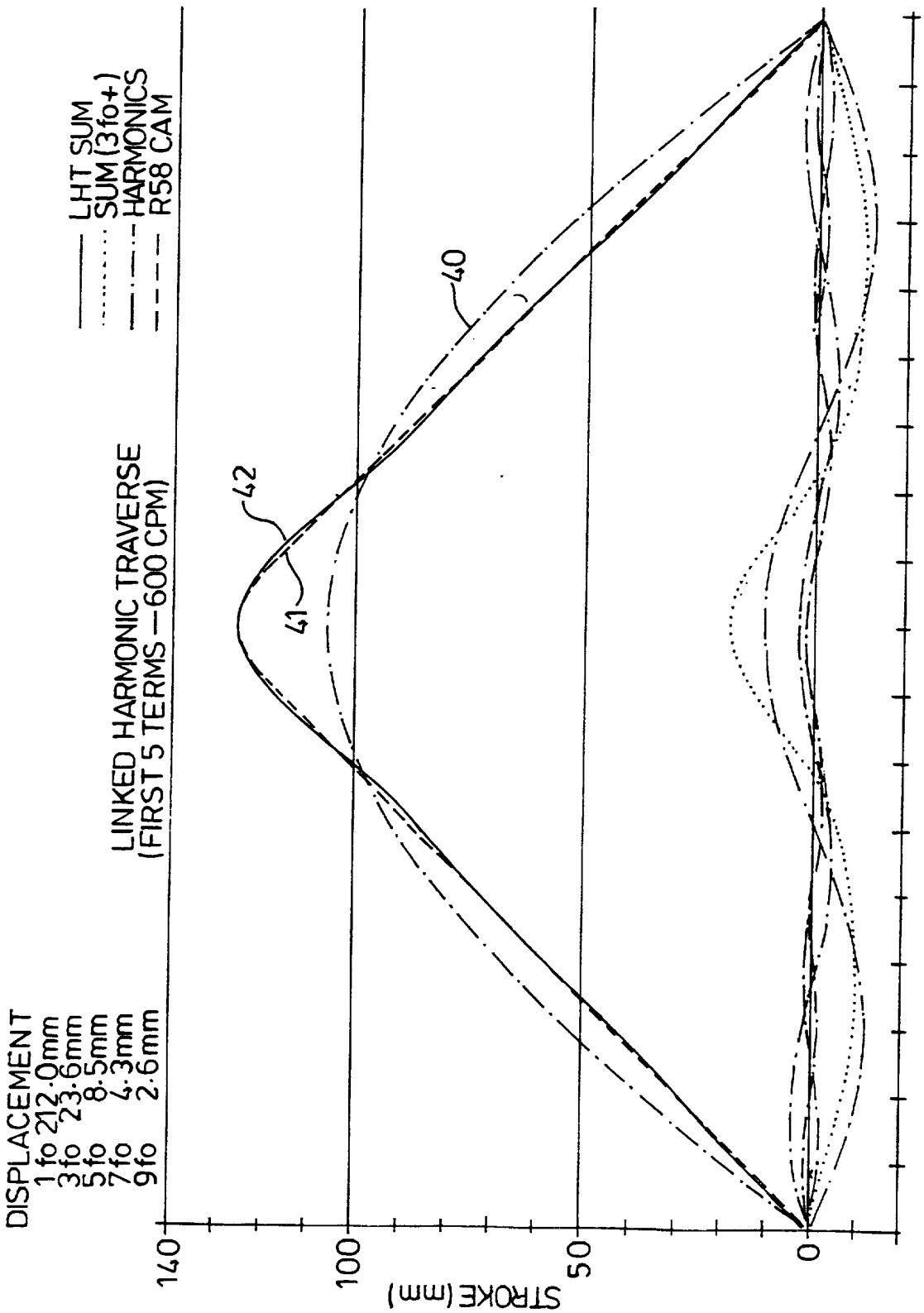
LHT SUM
SUM (3fo+)
HARMONICS
R58 CAM
LINKED HARMONIC TRAVERSE
(FIRST 5 TERMS — 600 CPM)
DISPLACEMENT
1 fo 212·0mm
3 fo 23·6mm
5 fo 8·5mm
7 fo 4·3mm
9 fo 2·6mm
140
100
50
0
STROKE (mm)
40
41
42

FIG.4

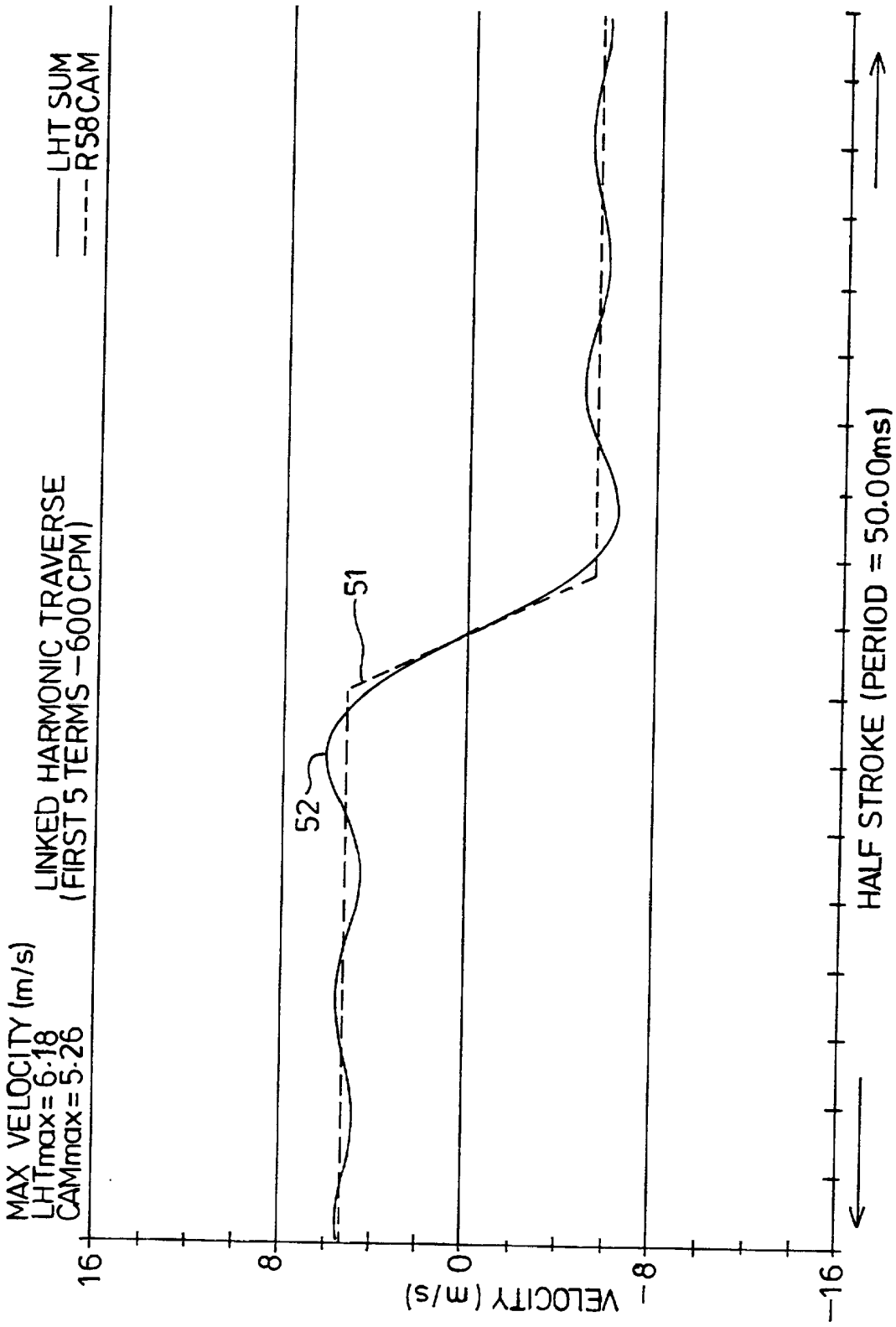
MAX VELOCITY (m/s)
LHTmax = 6·18
CAMmax = 5·26
LINKED HARMONIC TRAVERSE
(FIRST 5 TERMS – 600 CPM)
LHT SUM
RS8CAM
16
8
0
−8
−16
VELOCITY (m/s)
51
52
HALF STROKE (PERIOD = 50.00ms)

FIG.5

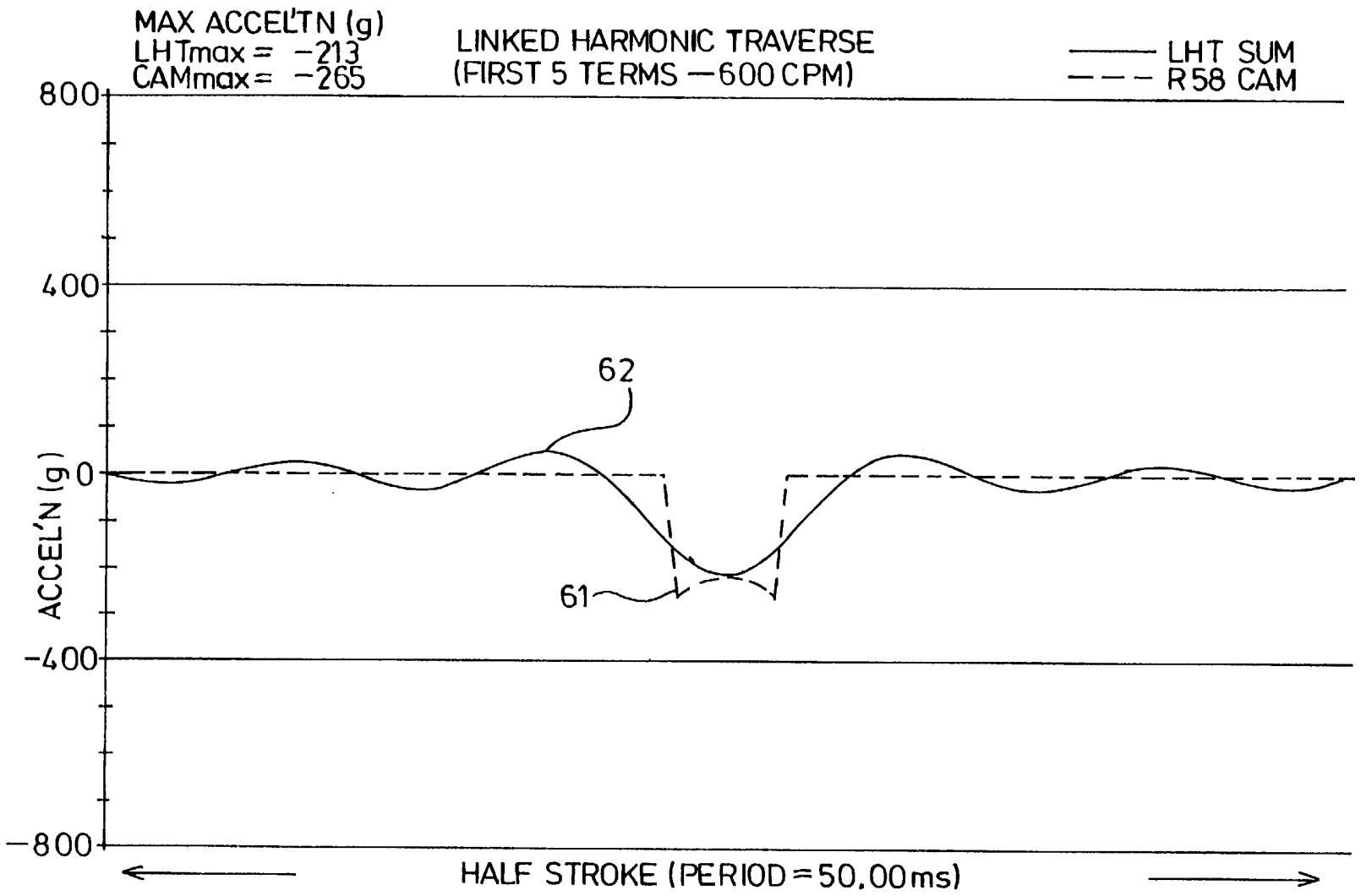
MAX ACCEL'TN (g)
LHTmax = −213
CAMmax = −265
LINKED HARMONIC TRAVERSE
(FIRST 5 TERMS −600 CPM)
LHT SUM
R58 CAM
800
400
0
-400
−800
ACCEL'N (g)
62
61
HALF STROKE (PERIOD = 50.00 ms)

FIG. 6

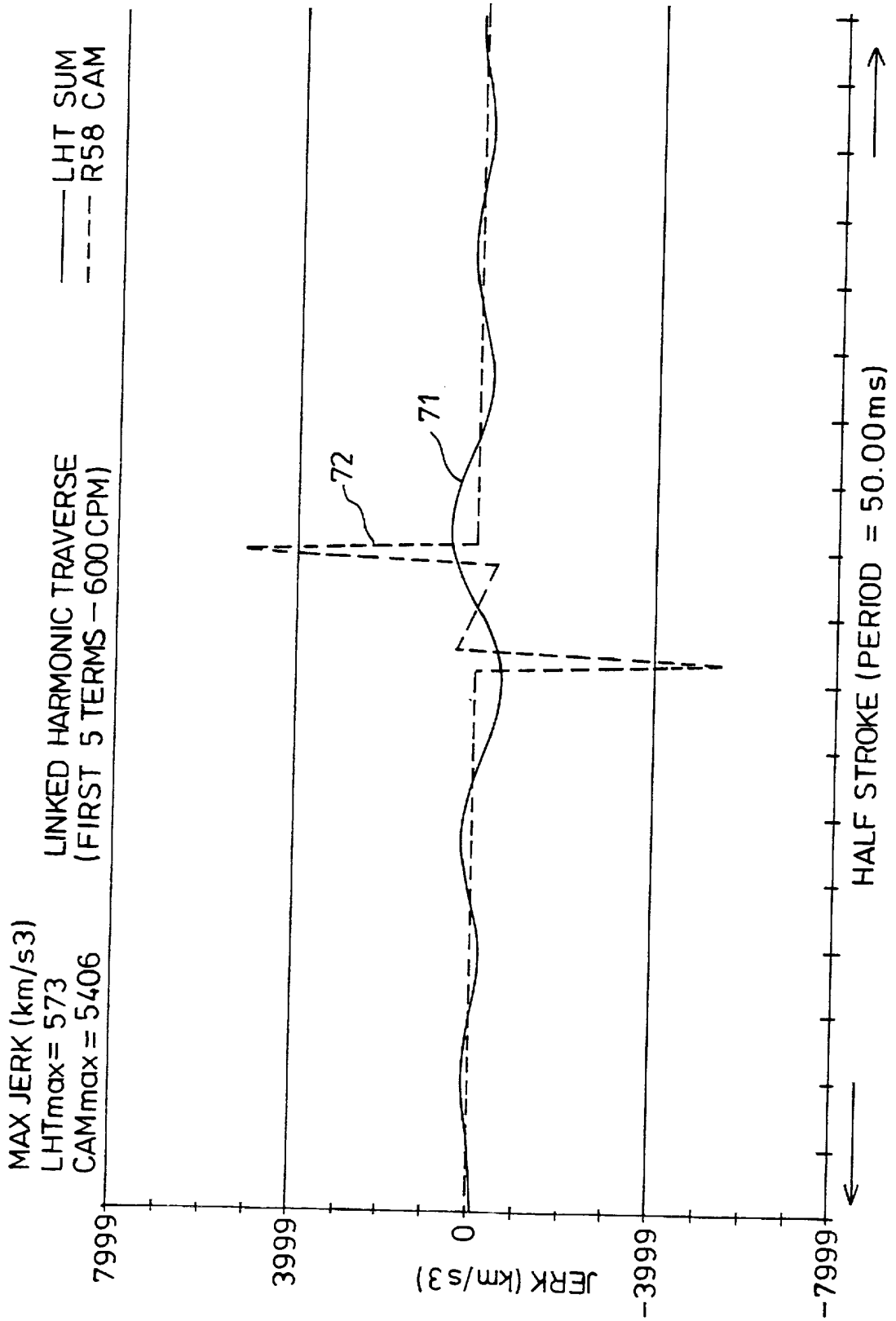
MAX JERK (km/s3)
LHTmax= 573
CAMmax= 5406
LINKED HARMONIC TRAVERSE
(FIRST 5 TERMS – 600 CPM)
LHT SUM
R58 CAM
72
71
7999
3999
0
-3999
-7999
JERK (km/s3)
HALF STROKE (PERIOD = 50.00ms)

FIG.7

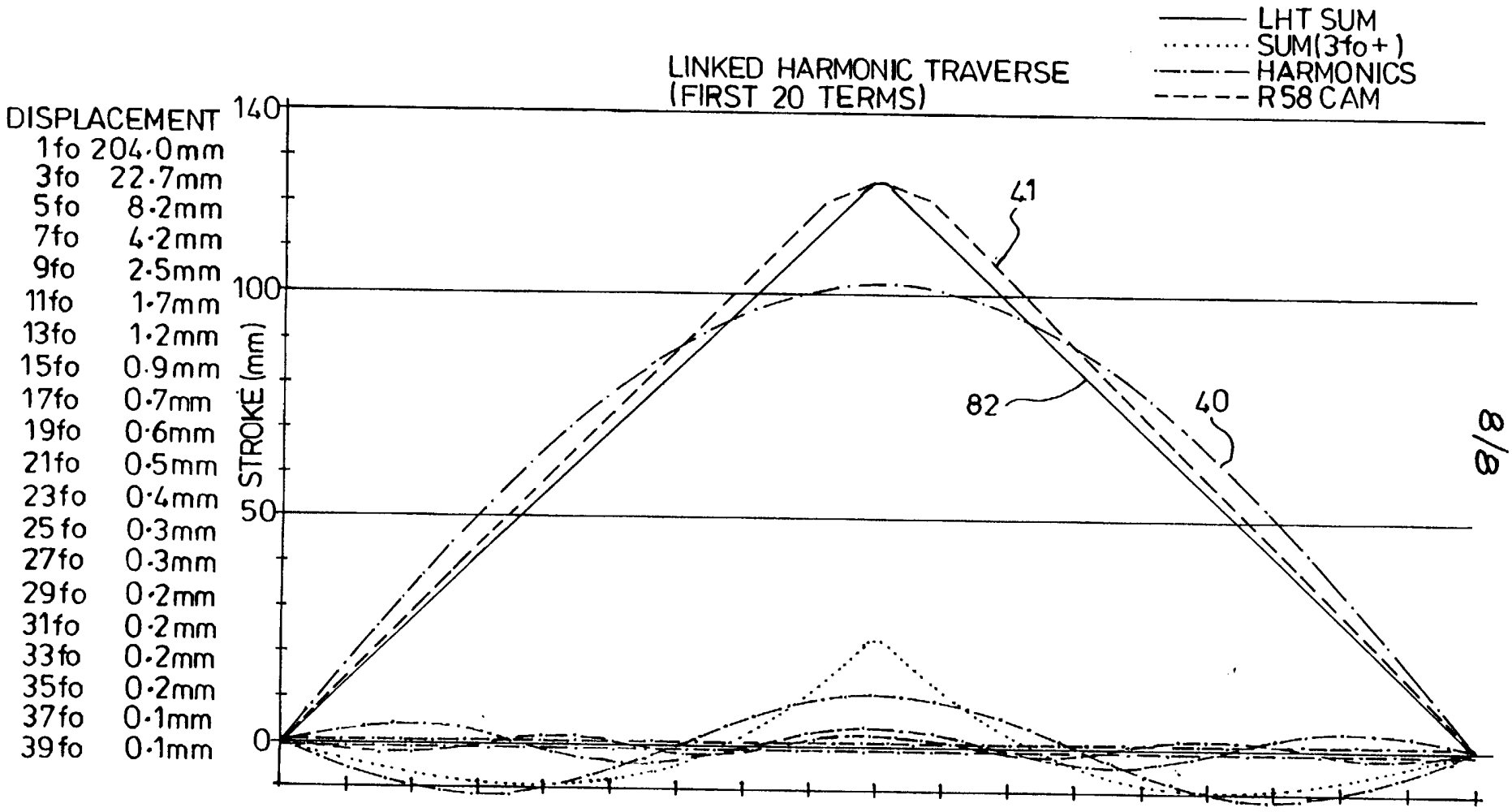
LHT SUM
SUM(3fo+)
HARMONICS
R58 CAM
LINKED HARMONIC TRAVERSE
(FIRST 20 TERMS)
DISPLACEMENT
1fo 204·0mm
3fo 22·7mm
5fo 8·2mm
7fo 4·2mm
9fo 2·5mm
11fo 1·7mm
13fo 1·2mm
15fo 0·9mm
17fo 0·7mm
19fo 0·6mm
21fo 0·5mm
23fo 0·4mm
25fo 0·3mm
27fo 0·3mm
29fo 0·2mm
31fo 0·2mm
33fo 0·2mm
35fo 0·2mm
37fo 0·1mm
39fo 0·1mm
140
100
50
0
STROKE (mm)
41
82
40

FIG.8

2345300

WINDING METHOD AND APPARATUS

This invention relates to yarn winding apparatus, and in particular to a method of and mechanism for traversing a running yarn to and fro parallel with the surface of a package on which the yarn is being wound.

There are many differing types of mechanism for producing the desired traversing motion. For example in one type of traversing mechanism the yarn is engaged by a yarn guide mounted on a reciprocating rod. In another type the yarn is engaged in a helical groove, or by a guide engaged in a helical groove, provided in a roller rotating about an axis parallel with that of the package. In yet another type the yarn is successively engaged by two yarn guides which are mounted on two oppositely moving endless belts, or on two oppositely rotating discs or arms. Each of these known types of traverse mechanism has its own disadvantages, mainly related to the inertia of the moving parts at the turnaround points at the two ends of the traverse stroke, the transfer of the yarn from one guide to another, or the ability to provide in the mechanism means for avoiding patterning on the package and/or ridged or collapsed package ends. For each of the above-mentioned types of traverse mechanism, devices and arrangements have been devised in order to avoid or minimise the disadvantages pertaining to the particular type of traverse mechanism, with varying degrees of success. However such devices and arrangements tend to complicate the traverse mechanism and increase considerably the cost of the textile machine on which such traverse mechanisms are fitted. Traverse mechanisms as described above require frequent maintenance and adjustment, and tend to be very noisy. Furthermore such traverse mechanisms are designed such that the turn round characteristics are as good as can be achieved with the design concerned at the maximum speed of operation of the mechanism. In consequence, when the machine is run at a lesser speed or wind angle as may be desirable for certain yarn processing applications, the dwell time at the end of each stroke is increased, thereby increasing the problems of ridged or collapsed package ends. For any speed of operation of the machine, a dwell time of zero is the ideal, but the above described arrangements are unable to achieve or even approach this ideal for the reasons given above.

It is an object of the present invention to provide a winding method and apparatus, in particular a traverse mechanism, which avoids or minimises the above-mentioned disadvantages in a relatively simple and cost effective manner, and which approaches as closely as possible the ideal zero dwell time at turn round for any speed of operation of the machine.

The invention provides a method of winding a yarn onto a package, comprising traversing the running yarn adjacent the package by means of a yarn guide connected to a traversing member, applying a primary reciprocating motion to the traversing member to cause a corresponding motion of the yarn guide, and superimposing on the motion of the yarn guide a secondary reciprocating motion to produce a linked harmonic traverse motion.

Preferably the primary motion is simple harmonic, and the secondary motion may be at least one harmonic of the primary motion. The secondary motion may be a combination of a plurality of harmonics of the primary motion, and may be a combination of the first four harmonics.

The invention also provides apparatus for winding a yarn onto a package, comprising a traversing member, drive means adapted to apply a primary reciprocating motion along a traverse path to the traversing member, a yarn guide connected to the traversing member to reciprocate therewith, and control means connected to the yarn guide whereby a secondary reciprocating motion is superimposed on the primary motion of the yarn guide to produce a linked harmonic traverse motion.

The control means may comprise a cam and a cam follower operated thereby and connected to the yarn guide. The traversing member may be resiliently biased towards a mid-position of the traverse path, and the drive means may comprise linear motor coils disposed along the traverse path. Alternatively the drive means may comprise an endless band to which the traversing member is connected and which is driven alternately in opposed directions, or may comprise a second cam and a second cam follower operated thereby and connected to the traversing member.

The invention will now be further described with reference to the accompanying drawings in which:

Fig. 1 illustrates a first embodiment,

Fig. 2 illustrates a second embodiment,

Fig. 3 illustrates a third embodiment,

Fig. 4 shows the displacement-time graph for differing traverse arrangements

Fig. 5 shows the velocity-time graph for differing traverse arrangements

Fig. 6 shows the acceleration-time graph for differing traverse arrangements

Fig. 7 shows the jerk-time graph for differing traverse arrangements, and

Fig. 8 shows the graph of Fig. 4 including a further traverse arrangement

Referring now to Fig. 1, there is shown a linked harmonic traverse (LHT) motion apparatus 10 for winding a yarn 11 onto a package 12. The apparatus 10 has a traversing member 13 which is biased by springs 14 towards a mid-position of a traverse path 15 parallel with the axis 16 of the package 12. The traversing member 13 is caused to reciprocate along the traverse path 15 by the energisation and de-energisation of successive linear motor coils 17. Such energisation and de-energisation of the coils 17 imparts a simple harmonic motion to the traversing member 13. A yarn guide 18 is connected to the traversing member 13 so as to have a corresponding simple harmonic motion therewith. The yarn guide 18 also is connected to a follower 19 which is guided in a cam groove 25 formed in a cam bar 24. The following of the cam groove 25 by the follower 19 provides that a secondary motion of the yarn guide 18 is superimposed on the substantially simple harmonic primary motion of the yarn guide 18 provided by the reciprocation of the traversing member 13. The shape of the groove 24 is such that the secondary motion is a combination of harmonics of the primary motion.

Referring now to Fig. 2, there is shown a LHT motion apparatus 20 for winding a yarn 11 onto a package 12. The apparatus 20 has a traversing member 13 which is connected to an endless band 21. The endless band 21, which may be a belt or wire, is driven by a reversible motor 22 in one and then the reverse direction so that the traversing member 13 reciprocates along a traverse path 15 parallel with the axis 16 of the package 12. Since the reversal of the motor 22 is not instantaneous, the motion of the traversing member 13 will approximate to simple harmonic. As in the previous case, a yarn guide 18 is connected to the traversing member 13 and to a follower 19 which is guided in a cam groove 25 formed in a cam bar 24. The shape of the groove 24 is again chosen relative to the speed and frequency of reversal of the motor 22 such that the superimposed secondary motion of the yarn guide 18 is a combination of harmonics of the primary motion.

Referring now to Fig. 3, there is shown a LHT motion apparatus 30 for winding yarns 11 onto packages 12 at respective yarn winding positions, two such positions being shown although there may be up to 36 disposed side by side along the length of a textile machine. The apparatus 30 has a traversing member 13 which is connected by a shaft 31 to the traversing members 13 at adjacent winding positions. The shaft 31 has a cam follower 32 engaged in an endless groove 33 in a cam roller 34 which is driven at a constant speed by a motor 22 so that

all of the traversing members 13 reciprocate along a respective traverse path 15 parallel with the axis 16 of the packages 12. The groove 33 in the cam roller 34 is such that the motion of the traversing members 13 is simple harmonic. A yarn guide 18 is connected to each of the traversing members 13 so as to have a corresponding simple harmonic motion therewith, and to a respective follower 19 which is guided in a cam groove 25 formed in a cam bar 24. The shape of the grooves 25 is such that the superimposed secondary motion of the yarn guides 18 is a combination of harmonics of the primary motion.

To achieve zero dwell time at turnaround, the ideal motion of the yarn guide would be one in which the displacement-time graph has a triangular waveform. This is not achievable with the known traverse arrangements in which the yarn guide has a motion for which the displacement-time graph is more nearly a sine wave of the form illustrated by curve 40 in Fig. 4. This indicates a long dwell time and would result in a package with unacceptably ridged or collapsed package ends. Curve 41 is that of an improved known arrangement in which the yarn guide is mounted on a follower engaged in an endless groove of a cam roller driven in rotation at constant speed. The shape of the groove in this known cam roller is such that there is an acceptable, though not ideal, finite dwell time leading to an acceptable build of package.

Fourier's theory states that any periodic curve may be considered as the combination of a number of sine curves of harmonically related frequencies. For a triangular waveform, this is represented mathematically by the equation:

$$f(t) = 4/\pi[\sin(t) - \sin(3t)/9 + \sin(5t)/25 - \sin(7t)/49 \qquad \pm \sin((2n-1)t)/(2n-1)^2]$$

The first term in this equation is a sine curve which, with the appropriate choice of parameters, would represent the motion of the traversing member 13 and give the displacement-time curve 40. However, if the shape of the groove 25 in the cam roller 24 is formed to give a secondary motion of the yarn guide 18 represented by the combination of the 2nd to 5th terms of the above equation, the resulting displacement-time curve is shown as curve 42. It can be seen that this curve 42 is very similar to the curve 41 of the known arrangement, with a similar dwell time. Hence by adapting the groove 25 to the first four terms of the equation, a winding apparatus, referred to as the LHT5 arrangement, is provided which winds packages to an acceptable standard. In Fig. 5, the velocity of the yarn guide in the known arrangement during the traverse cycle is shown by curve 51, and that of the yarn guide 18 in the LHT5 arrangement is shown by curve 52. It can be seen that the maximum velocity of the yarn guide 18 in the LHT5 arrangement is similar to that of the known arrangement. However the advantages of the LHT5 arrangement over the known arrangement are more evident on

consideration of Figs. 6 and 7. In Fig. 6 the acceleration of the yarn guide in the known arrangement during the traverse cycle is shown by curve 61, and that of the yarn guide 18 LHT5 arrangement is shown by curve 62. In Fig. 7 the jerk or rate of change of acceleration of the yarn guide in the known arrangement during the traverse cycle is shown by curve 71, and that of the yarn guide 18 in the LHT5 arrangement is shown by curve 72. It can be seen from these Figures that with the LHT5 arrangement the maximum acceleration of the yarn guide 18 is less than that with the known arrangement, and more significantly that the maximum jerk is considerably less. This, coupled with the fact that in the LHT5 arrangement only the small mass yarn guide 18 is moving with the linked harmonic motion and the larger mass traversing member 13 is moving with simple harmonic motion, has a considerable effect on the impact loading on the traverse mechanism and the noise produced during operation. In Fig. 8 the effect of adapting the groove 25 in the cam roller 25 to the 2nd to 20th terms of the Fourier's equation is shown as curve 82. It can be seen that this closely approximates to the ideal triangular waveform. Hence by adapting the groove 25 to the chosen number of terms of the equation, a desired waveform of the yarn guide 18 displacement-time graph can be achieved, thereby achieving the desired impact loading and noise reduction levels. In a machine having up to 216 processing positions, the noise reduction provided by the winding apparatus of the invention compared with the known arrangements is considerable and of great benefit to the operator. In addition, by means of the invention the previously mentioned disadvantages of the known arrangements are avoided of largely overcome in a simple and cost effective manner. The dwell time at turn round is reduced considerably compared with the prior arrangements thereby reducing the risk of ridged or collapsed package ends without incurring problems of high inertia or yarn transfer.

CLAIMS

1. A method of winding a yarn onto a package, comprising traversing the running yarn adjacent the package by means of a yarn guide connected to a traversing member, applying a primary reciprocating motion to the traversing member to cause a corresponding motion of the yarn guide, and superimposing on the motion of the yarn guide a secondary reciprocating motion to produce a linked harmonic traverse motion.

2. A method according to claim 1, wherein the primary motion is simple harmonic.

3, A method according to claim 2, wherein the secondary motion is at least one harmonic of the primary motion.

4. A method according to claim 3, wherein the secondary motion is a combination of a plurality of harmonics of the primary motion.

5. A method according to claim 4, wherein the secondary motion is a combination of the first four harmonics of the primary motion.

6. Apparatus for winding a yarn onto a package, comprising a traversing member, drive means adapted to apply a primary reciprocating motion along a traverse path to the traversing member, a yarn guide connected to the traversing member to reciprocate therewith, and control means connected to the yarn guide whereby a secondary reciprocating motion is superimposed on the primary motion of the yarn guide to produce a linked harmonic traverse motion.

7. Apparatus according to claim 6, wherein the control means comprises a cam and a cam follower operated thereby and connected to the yarn guide.

8. Apparatus according to claim 7, wherein the cam follower is guided in a cam groove formed in the cam.

9. Apparatus according to claim 8, wherein the shape of the cam groove causes the yarn guide to have a secondary motion which is a combination of harmonics of the primary motion.

10. Apparatus according to any one of claims 6 to 9, wherein the traversing member is resiliently biased towards a mid-position of the traverse path.

11. Apparatus according to claim 10, wherein the drive means comprises linear motor coils disposed along the traverse path.

12. Apparatus according to any one of claims 6 to 9, wherein the drive means comprises an endless band to which the traversing member is connected and which is driven alternately in opposed directions.

13. Apparatus according to claim 12, wherein the endless band comprises a belt or wire.

14. Apparatus according to claim 12 or claim 13, wherein the endless band is driven by a reversible motor.

15. Apparatus according to any one of claims 6 to 9, wherein the drive means comprises a second cam and a second cam follower operated thereby and connected to the traversing member.

16. A textile machine having a plurality of apparatuses according to claim 15 for winding yarn onto respective packages disposed in side by side relationship along the machine, wherein the second cam follower is connected to the traversing member of each winding apparatus.

Application No:	GB 9822412.4	**Examiner:**	G R A H A M WERRETT
Claims searched:	1-16	**Date of search:**	20 April 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): D1J.

Int Cl (Ed.7): B65H.

Other: Online : WPI, EPODOC, PAJ.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0462430 A1	(SCHARER) see e.g. accompanying abstract.	1, 6.
X	US 5370325	(BORER) see e.g. Col. 3 line 60 to Col. 4 line 36.	1, 6.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.