APPLICATION TO BE IN PERSONAL NAMES UNLESS BY BODIES INCORPORATED BY LAW.
COMMONWEALTH OF AUSTRALIA

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION
FOR A PATENT OR PATENT ADDITION

In support of the Convention application made by

PECO LIMITED

for a patent/patent of addition for an invention entitled...

"IMPROVEMENTS IN AND RELATING TO HARVESTING APPARATUS"

I/we SYDNEY ALBERT GOLDSMITH

of 51 Middleton Road, Christchurch, New Zealand

do solemnly and sincerely declare as follows:-

1. I am/we are the applicant(s) for the patent/patent of addition
   (or, in the case of an application by a body corporate)
   (oder im Falle einer Anmeldung einer juristischen Person)

2. The basic application(s) as defined by section 141 of the Act was/were made in the following country(ies) on the following date(s) by the following applicant(s) namely:-

   in NEW ZEALAND on 15th December, 1975
   by SYDNEY ALBERT GOLDSMITH and JOHN TAYLOR

3. I am/we are the actual inventor(s) of the invention referred to in the basic application
   (or, where a person other than the inventor is the applicant)
   (oder wenn der Anmelder eine andere Person als der Erfinder ist)

   SYDNEY ALBERT GOLDSMITH, aforesaid, JOHN TAYLOR, of
   14 Royalist Avenue, Christchurch, New Zealand, and
   RICHARD KLEINSCHAPFER, of 3 Audley Street, Kaiapoi,
   of North Canterbury, New Zealand

is/are the actual inventor(s) of the invention and the facts upon which the applicant(s) is/are entitled to make the application are as follows:-

The Applicant Company is Assignee of the actual Inventors.

4. The basic application(s) referred to in paragraph 2 of this Declaration was/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

Declared at CHRISTCHURCH, this 30th day of July, 1979

[Signature]
PAGE/S 3, 4, 5, 6, 7, 8, 10, 14, 16, 17 & 18

LODGED WITH THIS APPLICATION

ARE UNSUITABLE FOR REPRODUCTION.

THE PAGE/S

MAY BE INSPECTED AT THE PATENT OFFICE,

CANBERRA.
Claim 1. A drive arrangement for vibrating shaker head assemblies of a harvesting apparatus comprising at least one pair of vibrating shaker head assemblies each of the assemblies having an input and output member which mounted for rotation, a common prime mover coupled to both input members of a shaker head assembly pair, means for converting rotary motion applied to each input into a torsional vibration on its associated output member, the shaker head assemblies being coupled together so that the rotational motion supplied by the prime mover is transmitted to the input members through a power transfer means, said output members of the shaker head assembly pairs being mounted and coupled together so as to enable a rotary motion to be superimposed thereon and mounting means whereby the or each pair of shaker head assemblies is pivotable about an axis through the transfer means.
The following statement is a full description of this invention, including the best method of performing it known to us.

"IMPROVEMENTS IN AND RELATING TO HARVESTING APPARATUS"
BACKGROUND OF THE INVENTION

The present invention relates to harvesting apparatus and more particularly to a driving arrangement for shaker head assemblies of a harvesting apparatus usable to dislodge fruit, berries and a like produce by shaking and vibrating the produce, plants or bushes.

Known harvesting machines have been provided with shaker head assemblies for dislodging fruit, berries and the like produce and such mechanisms have included means which vibrate or shake the produce plants or bushes to dislodge the produce or fruit. The vibratory and shaking motion required on such machines has according to one method been produced by providing each shaker head assembly with its own power supply or by coupling two similar shaker head assemblies on opposite sides of the machine through a gear box so that the motion in each of the two shaker head assemblies counter balances the other. The production of such known machines has proved costly in that it has been necessary to provide additional parts, for example, a power supply for each of the shaker head assemblies or the inclusion of a gear box to transfer the power to a pair of shaker head assemblies mounted on either side of the harvesting machine.

When harvesting some types of berry fruit it is often difficult to ensure all the ripe or near ripe fruit which is to be harvested is shaken from the plant. This is partly caused by the vibrating tines not sufficiently penetrating the plant or following its counters. Harvesting machines have been provided whereby the shaker assemblies are mounted by a pivoted arm though whilst it could be said this type of
mounting increases the effectiveness of the shaker assembly
the main reason has been to allow the assembly free movement
if an obstacle is met.

An object of the present invention is to provide a
driving arrangement for shaker head assemblies of a harvesting
apparatus which couples pairs of shaker head assemblies so
that an impulse in one head assembly is balanced with the
impulse in the other head assembly of the pair.

It is a further object of the invention to provide a
harvesting apparatus having a drive arrangement for shaker
head assemblies which enables shaking and vibrating tines
mounted in operative communications with the shaker head
assemblies to conform to the shape or width or row of the
produce plant or bushes.

According to one aspect the invention can be said to
consist of a drive arrangement for vibrating shaker head
assemblies of a harvesting apparatus comprising at least one
pair of vibrating shaker head assemblies each of the assemblies
having an input and output member which are mounted for
rotation, a common prime mover coupled to both input members
of a shaker head assembly pair, means for converting rotary
motion applied to each input into a torsional vibration on
its associated output member, the shaker head assemblies
being coupled together so that the rotational motion supplied
by the prime mover is transmitted to the input members
through a power transfer means, said output members of the
shaker head assembly pairs being mounted and coupled together
so as to enable a rotary motion to be superimposed thereon
and mounting means whereby the or each pair of shaker head
assemblies is pivotable about an axis through said transfer
means.

In one form of the arrangement the pair of vibrating
shaker head assemblies is slidably mounted so that the power
supplied by the prime mover to the transfer means, which is
in the form of a shaft is transmitted by a drive means
mounted on a swinging or pivoting arm so that the position
of the pair of shaker head assemblies relative to the prime
move can be altered.

In still another form of the arrangement the pair of
vibrating shaker head assemblies is pivotal about an axis
through the transfer means and their position relative to the prime
mover can be altered.

According to a second aspect of the invention there is
provided a harvesting apparatus having a main frame movable
relative to the ground, a prime mover mounted thereon to
provide power for the relative movement between frame and
ground and a drive arrangement for shaker head assemblies
comprising a pair of vibrating shaker head assemblies mounted
on one, or a respective pair mounted on each, side of a
longitudinal horizontal axis of the harvester, each vibrating
shaker head assembly having an input and output member or shaft and including means which convert high speed rotational motion supplied to the input member or shaft into a torsional high speed vibration on its associated output member or shaft, the high speed rotation being supplied to the input members or shafts on the vibrating shaker head assemblies, said output members or shafts of each pair of shaker head assemblies being mounted so as to enable rotary motion to be superimposed thereon, the shaker head assemblies of the or each pair being located on a common mounting and coupled together so that they have the same rotational movement, the high speed rotational motion supplied by a prime mover being transmitted to the input members or shafts through a power transfer means said common mounting being pivotable about an axis through the transfer means, at least one set of radially spaced tines or fingers being positioned in operative connection with the output members or shafts whereby the or each set of radially spaced tines or fingers when in contact with produce plants or bushes as the frame moves through or thereover vibrates and shakes the plant or bushes to cause fruit, berries and the like produce to be dislodged therefrom.

In one form of the harvester the pair or pairs of vibrating shaker head assemblies are slidably mounted on rails so that the positions of the pair or pairs of shaker head assemblies relative to the prime mover can be altered,
the power from the prime mover being supplied to the transfer means, which is in the form of a shaft, through a drive means mounted on a swinging or pivoting arm.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a plan view from below of one form of the drive arrangement according to the invention, constructed for attachment to a straddle type harvesting apparatus, in which the main constructional features of the drive arrangement are shown but in which part of the frame members have been broken away for clarity.

Figure 2 is a sectional view taken on lines 2-2 of figure 1 showing the manner in which one pair of shaker head assemblies is driven and coupled together.

Figure 3 is a detailed elevation taken along the line of arrow 3 in figure 1 of one side of the coupling and transmission of power from the prime mover to a pair of the shaker head assemblies in which the swinging arm portion of the drive is rotated through 90° from the position shown in figure 1,

Figure 4 is a perspective view of the harvesting apparatus according to the invention,

Figures 5a-5d are schematic views of the pairs of shaker assemblies in various configurations when working on a bush or hedgerow, and
Figure 6 is a part view of the lower ends of a pair of shaker assemblies.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

The drive arrangement of the present invention, an example of which is in the accompanying drawings, is usable on known harvesting apparatus, for example, on straddle type harvesters which allow the frame of the harvester to pass over the plants, bushes or the like. The drive arrangement may also be fitted to harvesting apparatus such that the frame thereof may pass between rows of plants, bushes or the like so that plant engaging tines or fingers driven by the drive arrangement are directed outwardly of the frame to vibrate and shake the plants, bushes or the like to cause the fruit, berries and the like produce to be dislodged.

In the preferred form of drive arrangement shown in the drawings, the drive is mounted on frame members 1 and 2 which when attached to a harvesting apparatus extend transversely across a longitudinal axis A-A, i.e. the direction of travel of the harvesting apparatus, and are attached by any suitable means to the upper side members 51 of the frame of the harvesting apparatus.

A prime mover 3 (figure 3) is positioned on a plate 4 substantially centrally of the frame members 1 and 2 and arranged so that the drive shaft 5 thereof extends vertically downwards below the frame members 1 and 2. The prime mover 3, drive arrangement and ancillary equipment is housed beneath a cover 52.

The harvester broadly comprises a top frame 53 having side members 51, side frames 50 extending downwardly from the
side members 51, wheel supports 54 extending from the corners of top frame 53 and carrying at their lower ends land wheels 55 (the back pair of which are driven). Guide covers of the type shown at 56 can be provided at the front of the harvester to form a smooth inlet for plants or bushes. The driver sits on the top frame 53 in the area designated 57. Catch plates or trays and conveyors (not shown) extend along either or both sides of the harvester and are supported by the side frames. Elevating conveyor(s) 58 at the rear of the harvester lift collected produce for loading into containers carried on twin trailers pulled by the harvester. Other ancillary equipment such as guards, trash clearing system(s) etc are provided as may be required and will be well known to those in the art.

The lower end 6 of the drive shaft 5 of the prime mover 3 has mounted thereon transmission means arranged to transfer high speed rotational motion from the prime mover 3 to transfer shafts 7 and 8 which are positioned mid-way between shaker head assemblies 9 and 9'. The transmission of the high speed rotational motion to the transfer shafts 7 and 8 is effected by way of drive belts, chains or the like. For example pulleys may be mounted on the drive shaft 5 and positioned so that the motion is transmitted via belt drive to pulleys mounted on the transfer shafts 7 and 8.

In the preferred form shown in the drawings the lower end 6 of the drive shaft 5 is provided with a series of pulleys 10, 11 and 12. The pulley 10 is not essential but can be provided to drive, by way of a belt, a fan (not shown) usable on the harvesting machine to blow leaves or the like material from the collected produce. The pulleys 11 and 12 drive via
the intermediate shafts 13 (only one of which is shown in figure 3 for clarity) the transfer shafts 7 and 8.

As shown the intermediate shafts 13 are mounted on the outer end of swinging arms 15. The two arms 15 are mounted to move independently of each other. The inner ends 16 of the swinging or pivoting arms 15 are thus mounted in bearings 17 (figure 3) so that they each may move freely in a horizontal plane. The high speed rotational motion between the intermediate shafts 13 and the transfer shafts 7 and 8 is transmitted by belts 19 driven off pulleys 20 on the intermediate shaft 13 to pulleys 21 on the transfer shafts 7 and 8. Tension is maintained in the transmission means between the intermediate shaft 13 and the transfer shafts 7 and 8 by tension means 18 mounted between the two shafts.

The shaker head assemblies 9 and 9' (only one—9' which is shown in figure 1 for clarity) on either side of the drive arrangement are mounted on a movable mounting 22 which is supported by the frame members 1 and 2. The mounting 22 extends parallel to longitudinal axis A-A and is provided with stepped portions 23 at each end (figure 2) with wheels 24 which run in the frame members 1 and 2. Thus the distance between the axis of the drive shaft 5 and the axis of the transfer shafts 7 and 8 may be varied as each pair of shaker head assemblies is movable in the directions of the arrows B and C.

The shaker head assemblies 9 and 9' are similarly mounted on opposite sides of the harvester apparatus and the description of only one is included.

The rotational motion is transmitted from the upper pulleys 24 on the transfer shaft 7 to the inputs 25 of the
shaker head assemblies 9 by any suitable means for example, toothed belts 26 so that inputs of each of the shaker head assemblies 9 are rotating at a high speed in the same direction.

The shaker head assemblies 9 and 9' may be of any suitable construction (see for example New Zealand Patent Specification 1435013/65 which is hereby incorporated by way of reference) provided that the high speed rotational motion at the inputs 25 is converted to a torsional high speed vibration superimposed on output member 27.

The output members 27 when positioned in a harvesting apparatus are coupled by a universal joint 41 to a shaft 42 which is provided with at least one set of radially spaced tines or fingers 40 (preferably of fibreglass or plastics material construction) in operative connection therewith and positioned in the frame 50 of the harvesting apparatus so that the or each set of radially spaced tines or fingers 40 may contact the producing plants or bushes as the harvester moves thereover such that the vibrating radially spaced tines or fingers vibrate said plants or bushes to cause fruit, berries and a like produce to be dislodged.

The frame mountings 28 on which the shaker head assemblies 9 and 9' are arranged are preferably pivotable about a vertical axis through transfer shafts 7 and 8 on bearings 29 (figure 2) so that shaker head assemblies of each pair may be moved outwardly of the longitudinal axis A-A of the harvesting apparatus while the other shaker head assembly is maintained in its original position thus enabling the shaker head assemblies to readily move outwardly around posts or other projections which may interfere with the harvesting apparatus continued motion.
The lower ends of the tined shafts 42 are located in suitable bearings 43, arranged substantially vertically beneath the shaker head assemblies 9 and 9', the lower ends of the shafts 42 being rotatable in the bearings. The bearings 43 (see figure 6) are each located on an arm 44 which extends either side of a downwardly depending support 45. Two restoring springs 46 extend either side of a vertical frame member 50a on which they are mounted engage against pivoted arms 44' and urge it in toward the centre of the straddle frame. Support 45 is coupled at its upper end to mounting 22. Accordingly, the lower ends of the tined shafts 42 are normally urge to move toward the centre of the frame thus ensuring that in operation the tines 40 remain in engagement with the bush or hedgerow.

The shaker head assemblies 9 and 9' on either side of the longitudinal axis A-A are coupled together by any suitable means such as chain 30 so that the outer housings 9a of the pair of shaker head assemblies 9 on one side may rotate together in the direction of arrows 31. It will be appreciated that the pair of shaker head assemblies 9' on the other side of the harvesting apparatus will rotate in the opposite direction to the first pair and in the direction of arrows 31. The rotary motion is imparted to the shaker assembly housings by the tines 40 engaging with the plants.

In use the prime mover 3 transmits through its drive shaft 5 the high speed rotational motion which is in turn transferred to the intermediate shafts 13 on the swinging arms 15 which in turn transfers the motion to the transfer shafts 7 and 8 positioned midway between the shaker head assemblies 9
and 9' on either side of the harvesting apparatus. The high speed rotational motion in the transfer shafts 7 and 8 is transmitted to the input members 25 of the shaker head assemblies 9 and 9' by the transmission belts 26.

The shaker head assemblies 9 and 9' produce the torsional high speed vibration which is superimposed on to the output shaft 27 to which are connected the sets of radially spaced tines or fingers 40 on shafts 42 which contact and engage the producing plant and transmit the vibration to said plants to cause the fruits, berries and the like produce to be dislodged therefrom.

As previously discussed the shaker head assemblies 9 can move away from the longitudinal axis A-A in the direction of arrow B. Likewise shaker head assemblies can move in direction of arrow C. Additionally, the head assemblies 9 and 9' can pivot about the transfer shafts 7 and 8 respectively as shown by arrows 32 and 33. It will be appreciated that when a plant or bush passes between or against the leading shaker assembly of 9 or 9' will be forced outward, by either pivoting in direction 33, moving outward in direction B or C or a combination of both directions of movement. The trailing shaker head assembly 9 and 9' will likewise move outwardly to conform to the shaft of the plant or bush and as the plant or bush is exited from the harvesting apparatus the leading shaker head 9 and 9' assemblies are spring biassed to return to the original positions (see figures 5a-5d). As mountings 22 move outward in direction B or C the swinging arms 15 pivot about drive shaft 5 and thus a constant drive is applied to the transfer arm 7 or 8.

Referring to figure 5a the pairs of tined shafts 42 are
shown in schematic form when approaching a bush. It will be seen that the leading shafts 42 and their associated shaker heads 9 and 9' have moved outwardly from the longitudinal axis A-A so as to accommodate the increasing width of the bush.

Figure 5b shows the tined shafts 42 when the bush is completely within the frame of the harvester whereas figure 5c shows the positioning of the tined shafts 42 when the bush is coming clear of the harvester. Figure 5d shows the harvester traversing a hedgerow. It will be appreciated that as the tined shafts meet an increased width or hollow in a hedgerow they will conform to the contour in much the same way as shown in figures 5a and 5c. Accordingly in operation the tines gently follow the contours of the bushes or hedgerow and shake the branches without distortion or damage to cane growth or fruit.

The present invention preferably employs the shaker head assemblies of New Zealand Patent Specification 465673 though it will be appreciated that similar types of head assemblies could be used with success. In this type of head assembly the input of the shaker head is rotated by the prime mover and keyed to the input is an eccentric which locates in an arm pivoted at one end. The other end of the arm is pivoted to a crank which is fixedly attached to the output. The crank, arm and eccentric are located in a housing which itself is rotatably located in suitable bearings. Accordingly, the housing can rotate. In the present drawings the housing is shown at 9a and has a peripheral gear 47 around which chain 30 is engaged. As the harvester traverses a bush or plant the leading tined shaft 42, which is vibrating, engages the plant or bush and because of...
the harvester moving relative to the plant or bush the tined shaft 42 is rotated. This rotational movement superimposed on shaft 42 is transmitted to housing 9a and via chain 30 to the housing of the following head 9 or 9'. Accordingly, both output members 27 of the pairs of heads rotate at the same speed and direction. This has the effect that the vibration of one head relative to the other head is held constant. The nett result is what can be described as a balanced impulse operation where an impulse of combined vibrational and rotational movement in one shaker assembly head is transferred to and thus balanced by the other head assembly of the pair due to the coupled and timed operation effected by chain 30.

In further forms of the invention it is envisaged that by extending the input shafts of the shaker head assemblies upwardly and by including an additional transmission means a number of additional shaker head assemblies may be driven off the single drive arranged by extending the drive belt 26 from the shaker head assembly to the next adjacent shaker head assembly and also extending the timing chain 30 which maintains the same rotary motion on the outputs 27 of the shaker head assembly on each side of the harvester. Thus an additional number of shaker head assemblies may be readily incorporated into the harvesting apparatus and driven by a single drive arrangement with minimal additional cost.

A further modification would be to provide separate drives to each pair of shaker head assemblies. For example the transfer shafts could each be replaced by a hydraulic motor driven from the prime mover.

A particular form of the invention has been described by way of example and it is envisaged that modifications to and
variations of the invention may take place without departing from the scope thereof as defined in the claims.
The claims defining the invention are as follows:

1. A drive arrangement for vibrating shaker head assemblies of a harvesting apparatus comprising at least one pair of vibrating shaker head assemblies each of the assemblies having an input and output member which are mounted for rotation, a common prime mover coupled to both input members of a shaker head assembly pair, means for converting rotary motion applied to each input into a torsional vibration on its associated output member, the shaker head assemblies being coupled together so that the rotational motion supplied by the prime mover is transmitted to the input members through a power transfer means, said output members of the shaker head assembly pairs being mounted and coupled together so as to enable a rotary motion to be superimposed thereon and mounting means whereby the or each pair of shaker head assemblies is pivotable about an axis through the transfer means.

2. A drive arrangement as claimed in claim 1 wherein the pair of vibrating shaker head assemblies is slidably mounted so that the power supplied by the prime mover to the transfer means, which is in the form of a shaft, is transmitted by a pulley or like drive arrangement mounted on a swinging or pivoted arm so that the position of the pair of shaker head assemblies relative to the prime mover can be altered.

3. A drive arrangement as claimed in claim 2 wherein a shaker head assembly pair is mounted on each side of a longitudinal axis through the harvester.
4. A drive arrangement as claimed in claim 3 wherein each pair of shaker head assemblies is carried by an elongate frame, said frame being in turn carried by wheel assemblies located in spaced apart support members.

5. A drive arrangement as claimed in any one of the preceding claims wherein the shaker head assemblies in the or each pair are coupled by a positively engaging chain or belt extending therebetween and engaging with a gearing means located on the housings of each head assembly.

6. A drive arrangement as claimed in any one of the preceding claims wherein the input members are driven by a toothed belt extending from a gear wheel located on the transfer shaft, said transfer shaft being belt driven from the prime mover.

7. A drive arrangement substantially as herein described with reference to and as illustrated by the accompanying drawings.

8. A harvesting apparatus having a main frame movable relative to the ground, a prime mover mounted thereon to provide power for the relative movement between frame and ground and a drive arrangement for shaker head assemblies comprising a pair of vibrating shaker head assemblies mounted on one, or a respective pair mounted on each, side of a longitudinal horizontal axis of the harvester, each vibrating shaker head assembly having an input and output member or shaft and including means which convert high speed rotational motion supplied to the input member or shaft into a torsional high speed vibration on its associated output member or shaft, said output members or shafts of each pair of shaker head assemblies being
mounted so as to enable rotary motion to be superimposed thereon, the shaker head assemblies of the or each pair being located on a common mounting, and coupled together so that they have the same rotational movement, the high speed rotational motion supplied by a prime mover being transmitted to the input members or shafts through a power transfer means said common mounting being pivotable about an axis through the transfer means; at least one set of radially spaced tines or fingers being positioned in operative connection with the output members or shafts whereby the or each set of radially spaced tines or fingers when in contact with produce plants or bushes as the frame moves through or thereover vibrates and shakes the plant or bushes to cause fruit, berries and the like produce to be dislodged therefrom.

9. Harvesting apparatus as claimed in claim 8 wherein the pair or pairs of shaker head assemblies are slidably mounted on rails so that the positions of the pair or pairs of shaker head assemblies relative to the prime mover can be altered, the power from the prime mover being supplied to the transfer means, which is in the form of a shaft, through a drive means mounted on a swinging or pivoting arm.

10. Harvesting apparatus as claimed in claim 8 to 9 wherein the tines or fingers are constructed from fibreglass reinforced plastics or plastics material.

11. Harvesting apparatus as claimed in any one of claims 8 to 10 wherein the tines or fingers are mounted on shafts coupled by a universal joint to the output members of the shaker head assemblies, the lower ends of each shaft being located in a
bearing carried on a spring biassed arm.

12. Harvesting apparatus substantially as herein described and having the drive arrangement as claimed in any one of claims 1 to 6.

13. Harvesting apparatus substantially as herein described with reference to and as illustrated by the accompanying drawings.

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