COMMONWEALTH OF AUSTRALIA
PATENTS ACT 1952-1973

APPLICATION FOR A PATENT

We LANSING BAGNALL LIMITED, of Kingsclere Road, Basingstoke, Hampshire, England,

hereby apply for the grant of a Patent for an invention entitled:

"IMPROVEMENTS IN AND RELATING TO AN INDUSTRIAL TRUCK HAVING A ROTATABLE AND TRANSLATABLE LOAD CARRIER"

which is described in the accompanying specification.

The application is a convention application and is based on the application(s) for patent or similar protection made in GREAT BRITAIN on 13th May, 1976 under No. 19806/76

APPLICATION ACCEPTED AND AMENDMENTS ALLOWED

Our address for service is care of DAVIES & COLLISON, Patent Attorneys, of 1 Little Collins Street, Melbourne, in the State of Victoria, Commonwealth of Australia.

DATED his 16th day of May, 1977.

(a member of the firm of DAVIES & COLLISON) for and on behalf of the applicant

TO: The Commissioner of Patents
WODEN ACT 2606
DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT

In support of the Convention Application made for a patent for an invention entitled "IMPROVEMENTS IN AND RELATING TO AN INDUSTRIAL TRUCK HAVING A ROTATABLE AND TRANSLATABLE LOAD CARRIER"

1. David Carwardine, Director, of Lansing Bagnall Limited, Kingsclere Road, Basingstoke, Hampshire, England do solemnly and sincerely declare as follows:

1. I am authorised by LANSING BAGNALL LIMITED the applicant for the patent to make this declaration on its behalf.

2. The basic application as defined by section 141 of the Act made in Great Britain on the Thirteenth day of May 1976

   LANSING BAGNALL LIMITED, a British Company, by Manufacturers, of Kingsclere Road, Basingstoke, Hampshire, England

3. BRUNO KULICK, a Citizen of the German Federal Republic, Electrical Engineer and CECIL GOODACRE, a British Subject, Mechanical Engineer of Eichendorfstrasse, 33, 6719 Eisenberg-Steinborn, German Federal Republic and 2A Pack Lane, Oakley, Nr Basingstoke, Hampshire, England are the actual inventors of the invention and the facts upon which the applicant is entitled to make the application are as follows:

   by virtue of an Assignment dated: 23rd April 1977, whereby the said actual inventors assigned the invention to the said applicant

4. The basic application referred to in paragraph 2 of this declaration was, the first application made in a Convention country in respect of the invention the subject of the application.

DECLARED at Basingstoke this 23rd day of April 1977.
Claim 1. An industrial truck which has a load carrier that is mounted for independent rotation relative to the truck about a vertical axis and for translation relative to the truck in a horizontal plane, a power transmission for each movement, two motors, of which each is coupled to a respective one of the power transmissions to effect corresponding movement of the carrier, and a further transmission, including a slippable clutch, for connecting the two transmissions in phase synchronism.
Complete specification for the invention entitled:
"IMPROVEMENTS IN AND RELATING TO AN INDUSTRIAL TRUCK HAVING A ROTATABLE AND TRANSLATABLE LOAD CARRIER"

The following statement is a full description of the invention, including the best method of performing it known to us:
This invention relates to an industrial truck which has a load carrier, for example a pair of lifting tines, which is both rotatable about a vertical axis and translatable in a horizontal plane. The load carrier is rotatable and translatable independently in order that, for example, the truck can conveniently be used to load or unload to each side of the truck. Preferably but not essentially the load carrier is movable up and down on or as part of a mast. For conveying motive power to the load carrier there is normally a separate transmission for the rotary movement and for the translational movement; each transmission is normally driven by an electric motor. It is however also convenient to effect rotation and translation of the load carrier simultaneously in order, for example, while the truck is working in an aisle between two sets of storage racks, to move the lifting tines from a position in which they project from one side of the truck to a position in which they project from the other side of the truck. To achieve efficient, simultaneous rotation and translation the two movements should be synchronized and for this purpose it has been proposed to use electrical synchronization for the motors which provide motive power for the respective movements.

The present invention is a different arrangement of the mechanism for conveying motive power to the rotary and translational movements of the load carrier.

In some forms of the invention, in which two motors are used, the mechanical arrangement permits the sharing...
The invention facilitates the obtaining of synchronism between rotary movement and translatory movement of the load carrier if this is desired.

According to the invention, there is provided an industrial truck which has a load carrier that is mounted for independent rotation relative to the truck about a vertical axis and for translation relative to the truck in a horizontal plane, a power transmission for each movement, two motors, of which each is coupled to a respective one of the power transmissions to effect corresponding movement of the carrier, and a further transmission, including a slippable clutch, for connecting the two transmissions in phase synchronism.

The further transmission may be a chain drive which provides, on engagement of the said clutch, a fixed ratio between the movements of the transmissions for the rotary and translatory movements. Normally the mechanical advantages between, for example, the driven side of the clutch and each output drive member of the power transmission will be different. This difference may be accommodated whilst maintaining these two movements in phase synchronism by a chain drive which is coupled to the power transmissions by wheels of different diameter, the ratio of the diameters being determined by the particular configuration of the load carrier and the movements that it must perform.
Each movement of the carrier may be effected independently and the phase of one movement may be adjusted relative to the other. When the clutch is engaged, the two movements will be in phase synchronism and the combined load imposed on the motors by the rotary and translational movements may be shared.
Reference will here and after be made to the accompanying drawings, in which:-

Figure 1 is a plan view of part of a power transmission for an industrial fork-lift truck;

Figure 2 is an end view of the arrangement illustrated in Figure 1; and

Figure 3 is a schematic diagram of an electrical control circuit which may be used in conjunction with the power transmission.

The particular arrangement illustrated in the drawings is intended to form part of an industrial truck of the same general construction as that shown in British Patent Application No. 1395914, to which reference may be made for further details of the general construction and manner of operation of an industrial turret truck.

Figure 2 illustrates a motor 1 which provides motive power for a transmission, illustrated as the shaft 2, for the rotary movement of a turret head of the fork-lift truck. The translational movement of the head, from side to side across the truck, requires motive power from a motor 3. An output shaft of the motor 1 for the rotary movement drives a wheel 4 which is coupled by means of a chain 5 to a wheel 6 at one end of a lay-shaft 7. The chain 5 passes over a jockey wheel 8 (Figure 1) which is mounted in an adjustable bracket 9 in order that the tension in the chain 5 may be correctly adjusted. The lay-shaft is carried in brackets 10 and 11. A chain wheel 12 is freely mounted for rotation on the
lay-shaft 7 and connected to the output member of a clutch to be described later. Coupled to this wheel is a chain 13 which passes over a tensioning wheel 14 and a further chain wheel 15 which is mounted on an output shaft of the motor 3.

In this particular example, if the turret is to be both translated and rotated so as to bring its tines from a position extending from one side of the truck to a position in which the tines extend from the other side of the truck, the movements of the motors 1 and 2 are in opposite directions and are required to rotate at different speeds if the rotary movement and the translational movement are to be fully synchronized. In order to accommodate the reversed rotations of the motor, the chain 13 passes over two intermediate wheels 16 and 17 one at each side of the wheel 15. In order to accommodate the different mechanical advantages of the transmission from each motor to its respective rotary movement, the wheels 4, 6, 12 and 15 are of different diameter. In this particular example the diameters are in the ratio of 1.7 to 1.

Carried on the lay-shaft is a clutch 18, which in this embodiment is a magnetic clutch. When dis-engaged, there is no coupling between the motor 1 and the motor 3 or, in other words, between the power transmission for the rotary movement and the coupling between the motor 3 and the translational movement mechanism of the load carrier. Thus the two movements can be operated.
independently and out of synchronism. However, on engagement of the clutch, when it is desired to rotate the turret head in the space between two sets of storage racks the lay-shaft is effectively engaged for rotation with the wheel 12 and the two motors and their respective power transmissions are coupled together by the chain coupling comprising the wheels 4, 6, 12 and 15 and the chains 5 and 13. The operation of the two motors and clutch may be jointly controlled by closure of electric switches, one for each direction of rotation of the turret head, after the head has been traversed rearwardly of the racks.

If desired, one of the motors may be omitted. Then it is possible to rotate the load carrier without translating it from side to side across the truck or vice versa; but it is possible only to operate one movement independently of the other. If only one motor is used it is preferable to use a dog clutch so that when the clutch is re-engaged after having been released the rotary movement and the translational movement will be automatically re-engaged in proper phase with each other.

Electric interlock systems may also be incorporated in the circuits controlling the electric motors driving the above transmissions in order to ensure that the synchronised movements are completed once they are initiated.

Figure 3 illustrates schematically a control circuit, including the motors 1 and 3 and the clutch 18, which, for
the sake of an example, may be used in conjunction with the mechanism previously described.

The circuit includes a main positive line 30, a negative line 31 and an additional positive line 32; the positive lines and the negative line respectively would be connected to the positive and negative terminals of the battery that supplies power for the truck. The operation of the circuit is controlled by four push-buttons 33, 34, 35 and 36. Depression of these push-buttons initiates, respectively, a leftwards reach movement, a rightwards reach movement, a clockwise rotation and an anti-clockwise rotation of the load carrier. The reaching movement and the rotary movement of the carrier are produced by the motor 3 and the motor 1 as previously described. The motor for the reach movement has an associated control circuit 37 which, under the control of the push-buttons 33 and 34 by way of an interlock circuit 38, controls the direction of rotation, torque and speed of the motor. The circuit 37 may be of commonplace form. In like manner a control circuit 39 for the "rotate" motor 1 operates under the control of the push-buttons 35 and 36 through the intermediary of the interlock circuit 38. The circuits 37 and 39 include the electromagnetic contactor CON1 and the like contactor CON2 respectively; the contacts of the contactor have been shown separately from the two control circuits for the purpose of explanation. Each movement of the load carrier has, in accordance with usual practice, limit switches 40 and 41 respectively in order that the location of the
load carrier at any of the extreme limits of its movements in the translational and rotary senses may be signalled. The construction and manner for operation of the various parts of the control circuit of Figure 3 will be readily apparent to those familiar with industrial trucks and individually require no further explanation.

When synchronised movement of the load carrier in rotation and translation is selected by the operator of the truck, the interlock circuit 38, which governs the auxiliary control circuits 37 and 39 and monitors the states of the limit switches 40 and 41, prevents any conjoint rotation and translation of the load carrier unless the limit switches indicate that the load carrier is in an appropriate initial position, which may for example be at the extreme limit of a rightward (or leftward) movement across the truck and at the extreme limit of its clockwise (or anti-clockwise) rotary movement. If the load carrier is properly located the two motors 1 and 3 are started and the clutch 18 is energised. Rotation and translation of the carrier continue, until the load carrier reaches one or other of its limits of translational or rotary movement, according to the design of the truck or the preference of the designer. The respective limit switch thereupon de-energises the respective motor by opening the contacts of the respective contactor CON1 or CON2. The clutch 18 is connected in series with the contacts of these two contactors and accordingly the opening of the contacts of either contactor de-energises the coil of the clutch. The
clutch releases, as previously described, the coupling between the translatory and rotary mechanisms and thereby enables the movement which is not yet completed to be completed. Whichever movement of the load carrier is completed first, the other may always be permitted to continue until its proper termination.

Additional switches may be disposed to respond to movement of the load carrier in order, for example, to delay the commencement of the reaching movement until the load carrier has completed an initial, predetermined, angular movement or, contrariwise, to delay the commencement of rotary movement until the load carrier has been translated across the truck for a predetermined distance. It may be possible, with the aid of such additional switches, to reduce the width of an aisle necessary to accommodate the simultaneous rotation and translation of the load carrier.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An industrial truck which has a load carrier that is mounted for independent rotation relative to the truck about a vertical axis and for translation relative to the truck in a horizontal plane, a power transmission for each movement, two motors, of which each is coupled to a respective one of the power transmissions to effect corresponding movement of the carrier, and a further transmission, including a slippable clutch, for connecting the two transmissions in phase synchronism.

2. An industrial truck according to claim 1, in which the further transmission is a chain drive which provides, on engagement of the said clutch, a fixed ratio between the movements of the transmissions for the rotary and translatory movements.

3. An industrial truck according to claim 2 in which the chain drive is coupled to the power transmissions by wheels of different diameter.

4. An industrial truck according to any foregoing claim in which electrical switches are provided for controlling the motors and the clutch so that the rotary and translatory movements are initiated and completed at appropriate times.
5. An industrial truck according to claim 4, further comprising an electrical interlock to monitor the states of the switches and to prevent the conjoint movements of the load carrier unless earlier movements have been completed.

6. An industrial truck according to claim 1, substantially as hereinbefore described with reference to the accompanying drawings.

DATED this 5th day of February, 1980

LANSING BAGNALL LIMITED
by its Patent Attorneys
DAVIES & COLLISON.