

(21) Application No: 0715583.1

(22) Date of Filing: 09.08.2007

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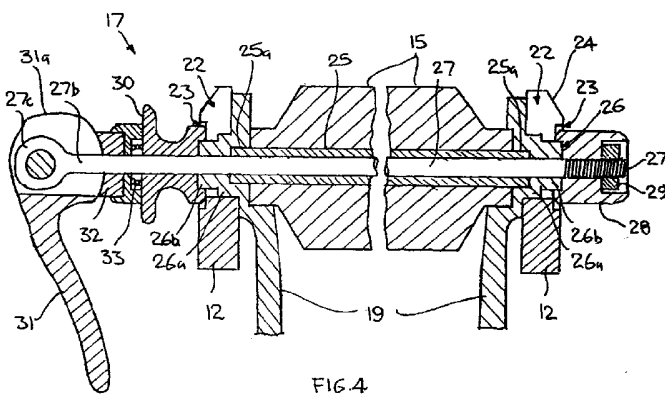
(51) INT CL:
B62K 15/00 (2006.01) **B62K 25/02** (2006.01)

(56) Documents Cited:
GB 2401590 A

(58) Field of Search:
INT CL **B62K**
Other: **ONLINE WPI EPODOC**

(54) Abstract Title: **Front wheel assembly for a folding bicycle**

(57) A front wheel assembly for a folding bicycle is intended for a bicycle having front wheel forks (12) provided with aligned open-ended slots (22) for mounting a front wheel and with recesses (23) at mutually remote sides of the forks. The assembly comprises a wheel with a hub (15), a wheel carrier carrying the wheel between two arms (19), the carrier being pivotably connectible with a frame of the bicycle to assist with folding the bicycle to a more compact size, and a quick-release clamp (17) for releasably fastening the wheel carrier and wheel to the forks. The arms (19) have coaxial spigots (26) which slidably engage in the fork slots (22). The clamp comprises a spindle (27), which extends through the hub (15) and spigots (26), and locating members (28, 30) arranged on free end portions of the spindle. The locating members have recesses receiving the spigots with a snug fit so as to interlock the components in such a way as to protect the spindle from bending loads in the event of improper application of the clamp.



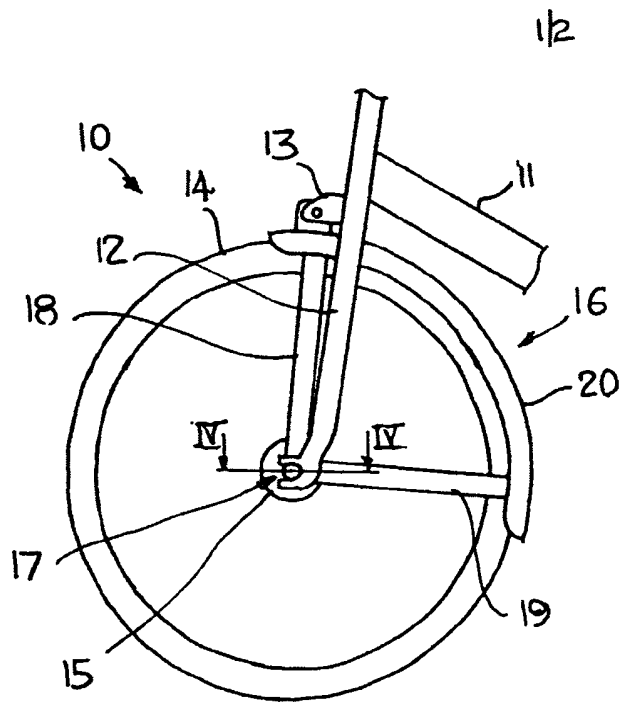


FIG. 1

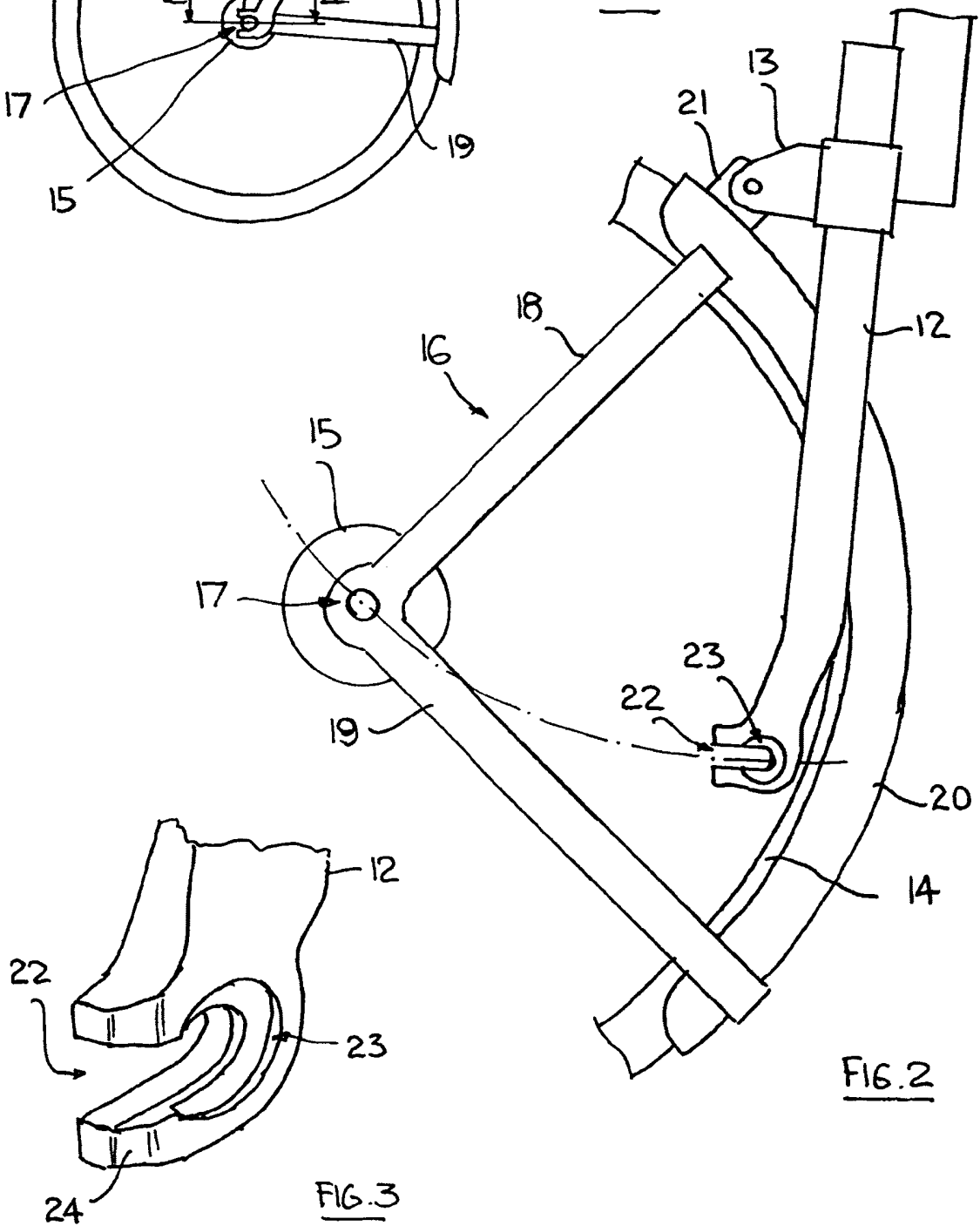


FIG. 2

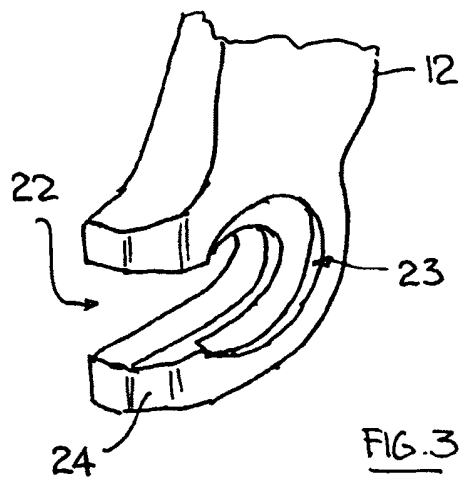
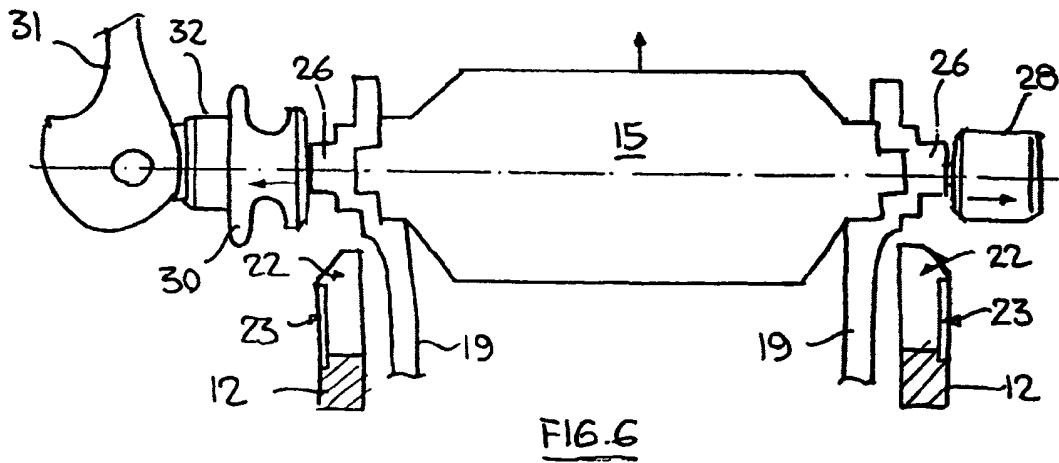
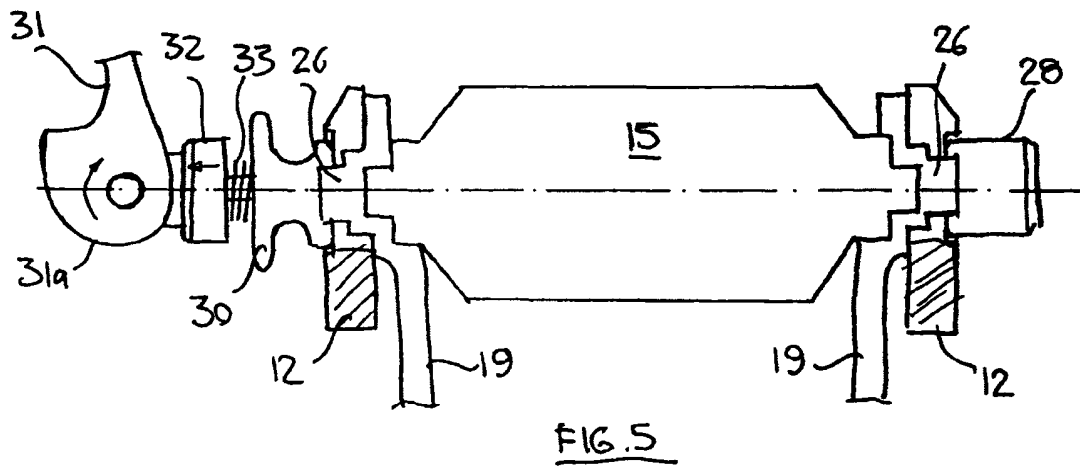
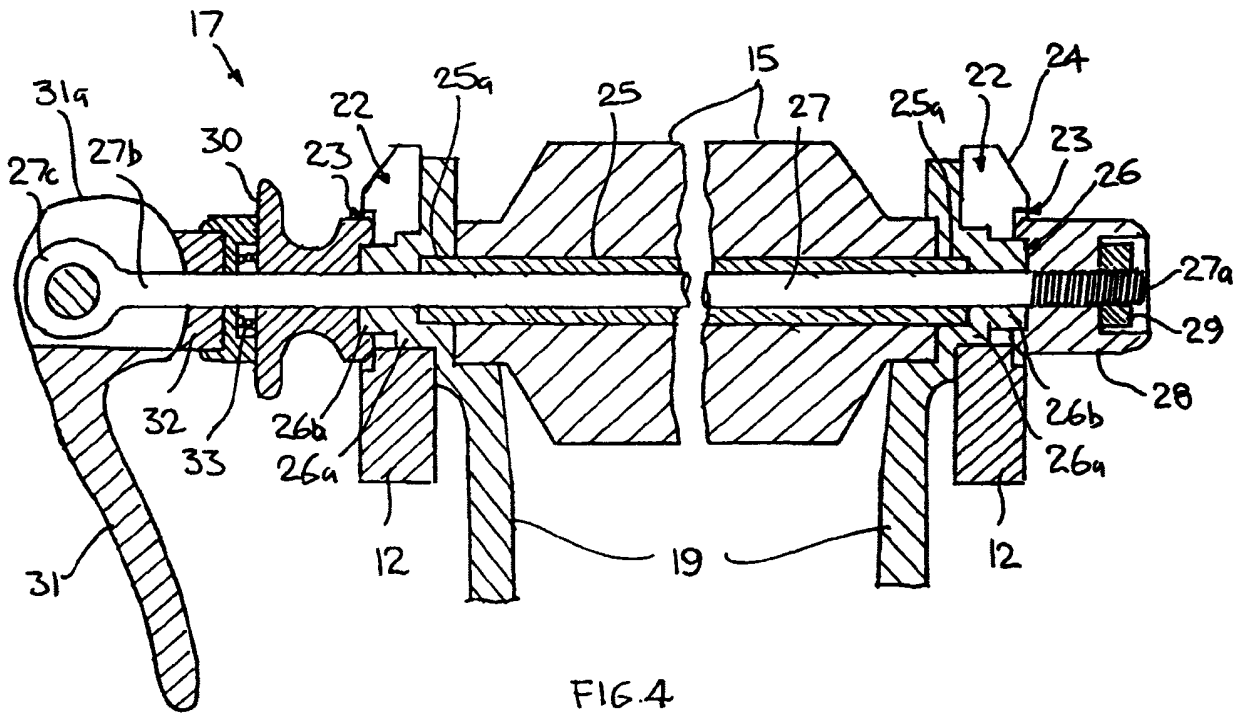


FIG. 3



FRONT WHEEL ASSEMBLY FOR A FOLDING BICYCLE

The present invention relates to a front wheel assembly for a folding bicycle and to a folding bicycle equipped with such an assembly.

Folding bicycles normally include, as an aspect of reduction to a more compact form, a folding front wheel which can be pivoted to, for example, overlie the bicycle frame. One such arrangement is described in the specification of United Kingdom Patent No. 2 401 590. This provides a wheel carrier pivotably connected to front wheel forks of the bicycle and carrying the wheel in the manner of a subframe. The wheel carrier with wheel is releasable from the forks by a quick-release clamp of a kind employed in non-folding bicycles to enable rapid wheel removal for the purpose of puncture repair or tyre replacement. Such clamps are relatively simple and convenient to operate, particularly by comparison with conventional methods requiring tools for wheel removal and refitting, but are accompanied by issues of safety and constructional integrity if the quick-release clamp is improperly applied and the wheel, despite appearances, is not securely fixed. In such circumstances the wheel may be loose in its mount and the risk then arises of detaching of the wheel from the forks when the bicycle is ridden. Measures have been proposed for safeguarding the wheel from detaching, i.e. keeping it retained in the forks even if still loose, but the problem is then present that riding of the bicycle in this state inevitably imposes loads on the clamp outside the original design specification and the risk arises, at least in the long term, of component distortion or fracture due to these loads.

It is therefore the principal object of the invention to provide a front wheel assembly for a folding bicycle in which the above-mentioned issues of safety and structural integrity are addressed so as to remove or at least reduce concerns applicable to existing designs.

Other objects and advantages of the invention will be apparent from the following description.

According to the present invention there is provided a front wheel assembly for a folding bicycle having front forks provided with aligned open-ended slots for mounting the hub of a front wheel and with recesses formed in the forks at mutually remote sides thereof and communicating with the slots, the assembly comprising a front wheel with a hub, a wheel carrier carrying the wheel between two carrier arms thereof and pivotably connectible with

the bicycle to be movable between a use position with the wheel fastened to the front forks of the bicycle and a folded position with the wheel removed from the front forks, and quick-release fastening means for releasably fastening the wheel carrier together with the wheel to the forks, the carrier arms receiving the hub of the wheel therebetween and each having a spigot which is coaxial with and projects away from the hub and which is slidably engageable in the slot of a respective one of the forks, and the fastening means comprising a spindle, which extends through the hub and the arms inclusive of the spigots and end portions of which protrude outwardly of the spigots, and a respective locating member arranged on each protruding end portion of the spindle and having a recess receiving the respectively adjacent spigot substantially without radial play, the locating members being relatively movable longitudinally of the spindle to enter into the recesses in the forks and being tightenable relative to one another to fix the spigots in the slots.

By virtue of the snug location of the spigots in the recesses in the locating members the loads that may arise if the locating members are not tightened relative to one another - as a consequence of which the spigots may be able to move in the slots in the forks, but still not escape from the forks due to continued reception of the locating members in the recesses in the forks - are absorbed by the spigots and kept away from the spindle, which in practice is normally of relatively small diameter and thus lesser load-bearing capability. The risk of breaking or bending of the spindle is eliminated or at least reduced by the interlocking of the locating members and the wheel carrier arms and the risk of accident, in the event of insufficient or absent tightening of the locating members, to a rider of a bicycle fitted with the wheel assembly is diminished.

The structural integrity of the front wheel assembly and thus the safety of a bicycle equipped with the assembly can be further enhanced if the hub has coaxial stub axles and the carrier arms have recesses receiving the stub axles. In that case, if the locating members are left or become untightened the resulting loads are additionally absorbed by the stub axles engaged in the carrier arm recesses. The stub axles, carrier arms and locating members then form a load-bearing unit capable of accepting the shock loads and stresses liable to occur due to the absence of firm fixing of the front wheel assembly in the bicycle forks. This unit isolates such loads from the comparatively low-strength - in terms of bending - spindle of the fastening means.

The spigots of the carrier arms preferably have smaller diameter parts seated in the

recesses in the locating members and larger diameter parts for seating in the slots in the forks. This step in the spigot diameter allows a relatively generously dimensioned width of fork slot, which is approximately matched by the width of the larger diameter part of the spigot, but avoids the need for oversizing the locating member, the recess in which only has to be dimensioned to accept the smaller diameter part of the spigot. It is entirely possible, however, for the spigot to be of unchanging diameter and to dimension the co-operating parts of the forks and quick-release fastening means to accommodate this diameter.

For preference, one of the locating members of the fastening means is threadedly engaged on the spindle and the other locating member of the fastening means is slidably engaged on the spindle and resiliently biased towards the threadedly engaged locating member. The threadedly engaged member can function as, for example, an adjuster nut by which the forces, for example clamping forces, to be exerted by fastening means can be appropriately preset. The slidably engaged locating member, on the other hand, can be arranged to be manually movable, for example against a spring bias, to assist with removal of the assembly from the forks after the clamping pressure has been released. The threaded locating member can be locked in a set position on the spindle by a lock nut similarly screwed onto the spindle.

The wheel carrier preferably includes a mudguard for the front wheels, in which case it can be advantageous to carry the wheel between the carrier arms of two pairs of arms which form, together with the mudguard, a rigid triangulated structure.

The invention also relates to a bicycle comprising a front wheel assembly as defined above. For preference, the slots in the forks of the bicycle are oriented in its fore and aft direction with the open ends of the slots facing forwardly. This orientation of the slots tends to promote gravitation of the assembly, if left loose, away from the open ends of the slots during riding and generally reduces the chances of the loose assembly departing from the slots except by intention.

An embodiment of the present invention will now be more particularly described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a schematic side view of a front wheel assembly embodying the

invention, the assembly being fitted to the front forks of a folding bicycle and shown in a use position;

Fig. 2 is a schematic side view, to an enlarged scale, of part of the front wheel assembly of Fig. 1, the assembly being removed from the front forks and shown in the process of being transferred to a folded position;

Fig. 3 is a perspective view, to an enlarged scale, of the lower end of one of the forks;

Fig. 4 is a schematic cross-section, to an enlarged scale, of the centre part of the front wheel assembly, along the line IV-IV of Fig. 1;

Fig. 5 is a schematic cross-section similar to Fig. 4, but of a scale enlarged to a lesser extent and showing the front wheel assembly in a state of partial release from the forks; and

Fig. 6 is a schematic cross-section similar to Fig. 5, but showing the front wheel assembly in a state of removal from the forks.

Referring now to the drawings there is shown a front wheel assembly 10 for a folding bicycle, which is illustrated only in fragmentary form in Fig. 1 and which includes, apart from elements which are not illustrated, a frame down tube 11 carrying a pair of front wheel forks 12 movable in usual manner by handlebars (not shown). The folding bicycle can be transformed from an extended use state to a folded state for carriage or storage. For this purpose the front wheel assembly 10, when incorporated in such a bicycle, is pivotably attached to a bracket 13 at the forks 12 to be pivotable between a use position in which the assembly is fitted to the forks, as shown in Fig. 1, and a folded position in which the assembly is removed from the forks. Fig. 2 shows the assembly released from the forks and in the process of transfer to a folded position, which is achieved by pivoting the assembly forwardly about a pivot axis at the bracket 13 and then turning the forks through approximately 180° to bring the assembly into overlapping relationship with the down tube 11.

The principal elements of the front wheel assembly 10 are a front wheel 14, which includes

a hub 15, a front wheel carrier 16 carrying the wheel 14 and a quick-release clamp 17 for fastening the wheel carrier 16 together with the wheel 14 to the forks 12. The wheel carrier 16 is a rigid structure composed - in this embodiment - of two pairs 18 and 19 of arms, the arms of each pair 18 or 19 being disposed on either side of the wheel 14 and each meeting an arm of the respective other pair 19 or 18 at the wheel hub 15, and a mudguard 20 uniting the arms in the region of the wheel circumference. The mudguard carries a lug 21 serving for the pivot coupling with the bracket 13. The quick-release clamp 17, which is indicated merely schematically in Figs. 1 and 2 and shown in more detail in Figs. 4 to 5, fastens the wheel carrier 16 to the forks 12 by way of mutually aligned open-ended slots 22 formed in the forks 12 to extend in the fore-and-aft direction of the bicycle with the slot open ends facing forwardly with respect to the direction of travel of the bicycle. The forks 12 are additionally formed, as shown in the enlarged detail view of Fig. 3, at mutually remote faces with circular recesses 23 each communicating with the respective slot 22, in particular in the vicinity of its closed end. Finally, the forks 12 have, in the vicinity of the open ends of the slots 22, chamfers 24 which assist in the process of refitting the front wheel assembly 10 to the forks 12 by urging components of the clamp 17 apart.

The front wheel assembly 10 described thus far is generally known and similar to that described in the specification of United Kingdom Patent No. 2 401 590.

The quick-release clamp 17 is shown in more detail in the schematic cross-section of Fig. 4, in particular in the state in which the wheel carrier 16, together with the wheel as represented by the hub 15 in the figure, is fastened by either one or both of the pairs of wheel carrier arms to the forks 12. The pair 19 of arms which are generally horizontal is shown in Fig. 4 by way of arbitrary choice; the point of fastening to the forks can equally well be disposed in the other pair 18 of arms or - preferably - at a junction common to both pairs. The plane of the cross-section in Fig. 4 passes centrally through the slots 22 and recesses 23 of the forks. The hub 15 includes a central tubular through axle 25, which extends beyond mutually opposite ends of a body of the hub to form protruding coaxial stub axles 25a. The body of the hub conventionally incorporates ball or other bearings (not shown) by which the wheel is rotatable about the axis of the stub axles 25a or axle 25.

Each of the arms of the pair 19 of carrier arms has a stepped-diameter spigot 26 coaxial with the stub axles and projecting away from the hub 15. An inner, larger diameter part

26a of each spigot is slidably engaged in the slot 22 of the associated fork 12 so as to couple the front wheel assembly 10 to the forks 12. An outer, smaller diameter part 26b of each spigot co-operates with a respective part of the quick-release clamp 17 as described further below.

The wheel carrier arms of the pair 19 additionally have, at mutually facing sides, recesses in which the stub axles 25a are seated to provide firm location of the hub 15 in the arms.

The quick-release clamp 17 comprises a spindle 27 which extends through the tubular axle 25 and through coaxial bores in the spigots 26 to protrude, by mutually opposite end portions, outwardly of the smaller diameter parts 26b of the spigots. One end portion 27a of the spindle is threaded and the other end portion 27b is plain, but terminates in an eye 27c. A respective locating member for locating the clamp 17, and with it the wheel carrier and wheel, in the forks 12 is placed on each of the end portions 27a and 27b.

The locating member placed on the threaded end portion 27a of the spindle 27 consists of a threaded adjuster nut 28 which is screwed onto the end portion 27a and which has at its inner end, i.e. end facing the hub 15, a recess firmly seating - thus without radial play - the smaller diameter part 26b of the respectively adjacent spigot 26. The nut 28 has at its outer end a recess accommodating a lock nut 29 similarly screwed onto the threaded end portion 27a of the spindle. The adjuster nut 28 is engaged, with a circumferential clearance, in the recess 23 of the associated fork 12.

The locating member placed on the plain end portion 27b of the spindle 27 consists of a waisted bobbin 30 which is slidably engaged on the end portion 27b and which has at its inner end, i.e. end facing the hub 15, a recess firmly seating the smaller diameter part 26b of the adjacent spigot 26. In similar manner to the adjuster nut 28, the bobbin 30 is engaged, with circumferential clearance, in the recess 23 of the adjacent one of the forks 12.

It can be seen from Fig. 4 that the engagement of the spigots 26 in the recesses in the adjuster nut 28 and bobbin 30 and the engagement of the stub axles 25a in the associated recesses in the wheel carrier arms produces a rigid assembly of interlocking components by which the spindle 27 passing through the components is effectively relieved of any load in bending. This means that the spindle 27 is substantially protected from bending stress,

which could potentially lead to distortion or even fracture in circumstances of improper application of the clamp 17 as described further below.

Pivotably coupled to the eye 27c is a cam lever 31 acting by way of a cam track 31a thereof on a two-part cam follower 32 bearing against an adjacent end face of the bobbin 30. The cam follower 32 has a cavity receiving a spring 33 similarly acting on the adjacent end face of the bobbin. In the applied state of the clamp 17 illustrated in Fig. 4 the cam lever 31 urges the slidably mounted bobbin 30, by way of the cam follower 32, towards the adjuster nut 28, which is fixed by its screw thread on the spindle 27, and thus clamps the entire wheel assembly 10 in place between the forks 12. In this state, the spring 33 is stressed, but ineffective. The principle of operation, including assembly and disassembly, of quick-release clamps of this kind is known and therefore not described in detail.

For release of the front wheel assembly 10 from the forks 12 the cam lever 31 is pivoted through approximately 180° so that a receding section of the cam track 31a comes into contact with the cam follower 32 and the pressure exerted on the bobbin 30 is relieved. Sufficient tolerance is then created for the bobbin to slide on the spindle 27. The spring 33 is now able to relax and displace the bobbin 30 away from the cam follower 32 to create the state depicted in Fig. 5, in which the clamping of the front wheel assembly 10 to the forks 12 is cancelled, but the assembly still remains attached to the forks due to the continued seating of the adjuster nut 28 and bobbin 30 in the recesses 23.

Removal of the assembly 10 entirely from the forks 12 is achieved by manually drawing the bobbin 30 back along the spindle 27 towards the cam lever 31 against the force of the spring 33 while simultaneously pushing the spindle a sufficient distance through the axle 25 to disengage the adjuster nut 28 from its associated fork recess 23. With both the bobbin 30 and the adjuster nut 28 clear of the recesses 23 the spigots 26 are free to slide out of the slots 22 in the forks for removal of the wheel assembly, as shown in Fig. 6. The arrows in Fig. 6 indicate the movement of the bobbin 30 towards the cam lever 31, the axial movement of the spindle to release the adjuster nut 28 from its recess 23 and the forward movement of the wheel assembly to detach from the forks.

Refitting of the assembly 10 to the forks 12 is carried out in reverse sequence, in the course of which, however, the chamfers 24 of the forks 12 co-operate with the adjusting nut 28 and bobbin 30 to cause the latter to slide along the spindle 27 towards the cam

lever 31 and thus spread the nut and bobbin sufficiently far apart to allow them to pass into the recesses 23 in the forks. Consequently, this aspect of refitting is executed automatically and it is not necessary to manually displace the bobbin against the biasing spring 33. The nut 28 and bobbin 30 have chamfered edges by which they slide along the chamfers 24 so as to provide a smooth action and to reduce wear.

The intermediate release state shown in Fig. 5 embodies an important safety aspect of the method of fastening the wheel assembly 10 to the forks 12 inasmuch as this state may arise not only intentionally in the course of removal of the assembly, but also unintentionally as a result of failure to correctly operate the cam lever 31 to generate the clamping pressure. In the event of failure to clamp the assembly in place and then riding of a bicycle with a front wheel assembly in such a condition, the spigots 26 of the wheel carrier arms will be able to move simultaneously to a limited extent in the fork slots 22, but not escape from the slots due to the continued engagement of the adjuster nut 28 and bobbin 30 in the recesses 23 of the forks, the resultant loads being evenly distributed to the nut and bobbin. The risk of accident due to sudden detaching of the front wheel assembly is avoided. It is in such an unclamped condition that the spindle 27, but for the interlocking of the clamp components by way of, in particular, the spigots 26 and also additionally by way of the stub axles, could be subjected to unacceptable bending loads. The interlocking of the wheel hub, carrier arms and locating members of the clamp accordingly provides improved constructional integrity and thus enhanced safety.

Modifications of the described embodiment of the front wheel assembly are possible without departing from the described principle of component interlocking. The spigots on the wheel carrier arms could be of uniform, rather than stepped, diameter, in which case appropriate change in the relevant dimensions of the locating members, the fork recesses that receive the members and, if necessary, the width of the slots in the forks may be needed. The tightening or clamping pressure in the quick-release clamp can be generated by other forms of cam and cam follower or by other systems for quick application and quick removal of tightening force.

CLAIMS

1. A front wheel assembly for a folding bicycle having front forks provided with aligned open-ended slots for mounting a front wheel and with recesses formed in the forks at mutually remote sides thereof and communicating with the slots, the assembly comprising a front wheel with a hub, a wheel carrier carrying the wheel between two carrier arms thereof and pivotably connectible with the bicycle to be movable between a use position with the wheel fastened to the front forks of the bicycle and a folded position with the wheel removed from the front forks, and quick-release fastening means for releasably fastening the wheel carrier together with the wheel to the forks, the carrier arms receiving the hub of the wheel therebetween and each having a spigot which is coaxial with and projects away from the hub and which is slidably engageable in the slot of a respective one of the forks, and the fastening means comprising a spindle, which extends through the hub and the arms inclusive of the spigots and end portions of which protrude outwardly of the spigots, and a respective locating member arranged on each protruding end portion of the spindle and having a recess receiving the respectively adjacent spigot substantially without radial play, the locating members being relatively movable longitudinally of the spindle to enter into the recesses in the forks and being tightenable relative to one another to fix the spigots in the slots.
2. An assembly as claimed in claim 1, wherein the hub has coaxial stub axles and the carrier arms have recesses receiving the stub axles.
3. An assembly as claimed in claim 2, wherein the stub axles are provided by end portions of a through axle on which a body of the hub is rotatably mounted.
4. An assembly as claimed in any one of the preceding claims, wherein the spigots of the carrier arms have smaller diameter parts seated in the recesses in the locating members and larger diameter parts for seating in the slots in the forks.
5. An assembly as claimed in any one of the preceding claims, wherein one of the locating members of the fastening means is threadedly engaged on the spindle and the other locating member of the fastening means is slidably engaged on the spindle and resiliently biased towards the threadedly engaged locating member.

6. An assembly as claimed in claim 5, wherein the fastening means comprises a lock nut threadedly engaged on the spindle to lock the threadedly engaged locating member in a set position on the spindle.
7. An assembly as claimed in claim 5 or claim 6, wherein the fastening means comprises over-centre cam means acting on the slidably engaged locating means to produce the tightening of the locating members relative to one another.
8. An assembly as claimed in any one of the preceding claims, wherein the wheel carrier includes a mudguard for the front wheels.
9. A folding bicycle comprising a front wheel assembly as claimed in any one of the preceding claims.
10. A bicycle as claimed in claim 9, where the slots in the forks are oriented in the fore and aft direction of the bicycle with open ends of the slots facing forwardly.

Application No: GB0715583.1

Examiner: Roger Binding

Claims searched: 1-10

Date of search: 27 November 2007

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	GB 2401590 A (ATB SALES), see drawings.

Categories:

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.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X:

Worldwide search of patent documents classified in the following areas of the IPC

B62K

The following online and other databases have been used in the preparation of this search report

Online WPI EPODOC

International Classification:

Subclass	Subgroup	Valid From
B62K	0015/00	01/01/2006
B62K	0025/02	01/01/2006