PATENT SPECIFICATION

DRAWINGS ATTACHED

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907,467

Date of filing Complete Specification (under Section 3 (3) of the Patents Act, 1949): Oct. 27, 1960.

Application Date: Nov. 16, 1959. *No. 38781/59.*

Application Date: March 3, 1960. *No. 7572/60.*

Complete Specification Published: Oct. 3, 1962.

Index at acceptance:—Classes 136(3), A1, A31(A:D:H:M1B); and 136(1), G2DX, J12X.

International Classification:—B62k. B62j.

COMPLETE SPECIFICATION

Improvements in Pedal Cycles

We, MOULTON CONSULTANTS LIMITED, a Body Corporate duly organised under the Laws of Great Britain, of The Hall, Bradford-on-Avon, Wiltshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to two wheeled pedal cycle vehicles, that is to say pedal bicycles, motorized bicycles or mopeds.

A conventional modern pedal "safety" bicycle of the diamond frame type intended for adult riders and provided with normal wheelbase and a normal crank-throw has a layout which includes a triangular disposition (when viewed in side elevation) of the three points, the seat, the handlebars and the pedal crank axle housing in vertical relation to the ground and in longitudinal relation to the wheelbase, which is generally accepted in the art. The actual configuration of the triangle formed by the disposition of these three points will of course be appropriate to the stature of the rider and to the mode of riding. Such a layout is referred to hereinafter as a "conventional layout".

Such conventional "safety" bicycles normally have rubber tyred wheels of an overall diameter of between 24 and 30 inches. In this Specification by "wheels of small diameter" is meant rubber tyred wheels having an overall diameter of between 12 and 19 inches and preferably of the order of 16 inches.

According to the present invention a pedal bicycle or moped having a conventional layout as above defined is provided with both front and rear rubber tyred wheels each of an overall diameter of between 12 and 19 inches and a frame comprising a substantially straight main frame member extending rearwardly from a point above the front wheel towards the rear wheel, said main frame member having upstanding substantially at right angles from its front end a post member housing a steering column and surmounted by handlebars, and from a point intermediate of its length and immediately above a housing for a pedal crank axle which housing is located directly at its underside, and in contact therewith a seat tube surmounted by a saddle, said post member and said seat tube being of a length equal to at least half the distance between them and being joined at their lower ends to said main frame member to form a frame of open F-shape.

The main frame member or backbone, the steering post and the seat tube are advantageously of tubular construction, the steering post and the seat tube being so joined to the backbone that the latter is not pierced or apertured at the junctions.

Preferably the backbone is formed of hollow tubing which has a greater depth than width and advantageously its cross section is that of a flat sided oval or ellipse having its minor axis horizontal.

Alternatively the backbone may be formed from a plurality of tubes clustered together, and advantageously two or more tubes are employed, attached together and superimposed one above another.

The backbone, the seat tube and the steering post may be either light alloy extrusions or the tubes may be formed from steel pressings joined together to form tubes.

Preferably the frame elements are joined together without employing lug joints, brazed or welded lap joints suitably being used.

The backbone may be in two parts so as to be collapsible or able to be hinged for storage or transportation.

Preferably also the backbone terminates at a point ahead of the rear wheel and provides a mounting for rearwardly extending forks carrying the rear wheel spindle or it may provide a mounting for a resilient suspension system for the rear wheel. Similarly the front wheel may be carried on forks mounted at the base of the steering column, but prefer-

[*Price 4s. 6d.*]

ably however an arcuate member depends from the steering column rearwardly of the front wheel and at its lower end provides a mounting for a leading arm structure on which the front wheel is resiliently carried. Alternatively this arcuate member may depend forwardly of the front wheel to provide a mounting for a trailing arm carrying the front wheel.

The wheels will suitably be provided with pneumatic tyres but solid tyres may be used, particularly when the wheels are resiliently supported.

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

Figure 1 is a simplified side view of one embodiment of a bicycle according to the invention and having a conventional layout as hereinbefore defined but with wheels of small diameter, shown superimposed on the outline of a 'safety' bicycle having a conventional layout.

Figure 2 is a side view of a preferred embodiment of the invention.

Figure 3 is a cross-sectional view ~~on~~ larger scale taken on the line III—III of Figure 2 (with moving parts omitted).

Figure 4 is a side view of a preferred front wheel suspension arrangement for the embodiment shown in Figure 2.

Figure 5 is a perspective view of the front fork assembly shown in Figure 4.

Figure 6 is a side view of a preferred rear wheel suspension arrangement for the embodiment shown in Figure 2.

Figure 7 is a perspective view of the rear fork assembly shown in Figure 5.

Figure 8 is a side view of a simplified embodiment of the invention.

Figure 9 is a side view of a fully equipped version of the embodiment illustrated in Figure 2.

Referring now to Figure 1, a bicycle having a conventional layout as hereinbefore defined, with front and rear wheels 11 and 13 respectively of small diameter, is provided with a frame comprising a backbone 1, extending from a point above and near the top of the front wheel 11 in a straight line towards the spindle 12 of the rear wheel 13, said backbone 1 passing through a point near the housing 20 for a pedal crank axle which housing 20 is adjoined directly to the under side of the backbone 1.

The backbone 1 has upstanding from it substantially at right angles, from its front end above the front wheel 11, a steering post 2 for pivotally supporting a steering column 6 at the upper end of which are mounted handlebars 7 on a stem 8 and from a point near the housing 20 for the pedal crank axle a seat tube 3 upstands substantially at right angles from the backbone 1. A seat or saddle 4 is carried on a stem 5 at the upper end of the tube 3.

It will be appreciated that the bicycle having small wheels according to the invention illustrated in this Figure is provided with a conventional layout. That is to say that when compared with the outline of the conventional 'safety' bicycle shown in dotted lines, the wheel base (i.e. the distance between the front and rear wheel centres) is similar, the crank throw (i.e. the length of the pedal cranks) is similar and the triangular disposition (when viewed in side elevation) of the three points, the seat 4, the pedal crank axle housing 20 and the handlebars 7 is identical in the two machines shown in this representation. It is to be emphasized that a bicycle according to the present invention has a conventional layout in these respects such as to provide a riding position well known in the art. This layout will however vary slightly and the actual configuration will be appropriate to the stature of the rider and to the mode of riding.

This representation illustrates also the difference in overall length of the two machines and the low 'step-over' height of the small-wheeled bicycle according to the invention, enabling it to be mounted by riders of either sex with equal ease. Moreover it will be seen that very large areas, shown dotted at 30 and 31, are available above the front and rear wheels but within the overall height and length of the machine according to the invention, such areas being suitable for luggage accommodation.

Further features of a bicycle having wheels of small diameter and a frame according to the invention will now be described with reference to Figure 2 which shows a bicycle generally similar to that illustrated in Figure 1, corresponding reference numerals being employed for like or equivalent parts.

21 and 22 are pedal cranks carrying pedals 23 and 24 for rotating a chain wheel 25 driving a rear sprocket 26 by a conventional chain 27 having a chain guard 28.

Adjustability of the height of the seat 4 is obtained by clamping means having a manually rotatable nut and bolt locking device indicated at 39 and functioning in known manner to clamp the stem 5 at the required position within the tube 3. Similarly clamping means 40 of known kind maintains the stem 8 carrying handlebars 7 at the required height and position relative to the steering column 6 carried within the post 2.

At the lower end of the steering column 6, an arcuate member 50 depends rearwardly of the front wheel, it being understood that such arcuate member 50 is arranged to turn with the steering column when the handlebars 7 are rotated. At its lower end the arcuate member 50 is provided with a substantially horizontal pivot or bearing 51 on which is carried a leading arm structure generally designated 52 having at its front end means for mounting the

spindle 10 of the front wheel 11. The leading arm structure 52 is able to pivot in a vertical plane (when the machine is upright) about the bearing 51 and this pivotal movement is resiliently controlled by means of a single spring 55, suitably a rubber compression spring, connected between the structure 52 and the member 50.

A generally similar arrangement is utilized for resiliently supporting the rear wheel 13. In this case a substantially horizontal pivot or bearing 61 is provided at the rear of the backbone 1 for pivotally mounting a trailing arm structure generally designated 62 able to pivot in a vertical plane (when the machine is upright) and controlled by a single spring 65 connected between the structure 62 and the backbone 1.

The front end of the backbone 1 is formed with two ears 70 arranged to embrace the steering post 2 to which they are attached by brazing or welding or alternatively by an adhesive.

32 is a combined carrying handle and stay between the backbone 1 and the seat tube 3 which may be extended through the latter to provide a mounting for a carrier, shown in dotted outline at 33 having a pair of stays 34 carried from the device 39.

Front and rear brakes 56 and 66 respectively, which are of known kind, are suitably carried on the wheel supporting structures so as suitably to be positioned to engage the wheel at all times. Front and rear mudguards 100 and 101 respectively are also mounted on the wheel supporting structures.

The preferred method of joining the tube 3 and the housing 20 to the backbone 1 is shown in detail in Figure 3 which is a cross-sectional view through the line III—III in Figure 2. From Figure 3 it will be seen that the cross-section of the backbone 1 is that of a flat sided oval with its minor axis horizontal. At its juncture with the housing 20 for a pedal crank axle (not shown) the underside of the backbone is "dimpled" as indicated at 71 in such manner that the generally cylindrical housing 20 fits snugly into the concavity of the dimple 71 and is fixed therein by brazing or welding or by an adhesive over the full width of the backbone. The lower end of the tube 3 is shaped to form two generally triangular ears 72, which embrace the backbone 1 and are attached on either side thereof by brazing, welding or adhesive.

It will be noted that the juncture of the members illustrated in Figure 3 does not involve lug joints, which are expensive, nor does it necessitate the piercing or aperturing of the backbone whose structural strength is not thereby impaired. One of the main characteristic features of the invention is also apparent from this Figure namely the feature of the housing 20 being attached directly to the underside of the backbone, as opposed to being located some distance below it. This feature ensures the torsional rigidity of the frame during pedal thrusts in a simple and economical manner. It will also be appreciated whereas in the frame of a conventional "safety" bicycle there are at least eight joints, usually brazed lug joints of a relatively expensive type, in the present invention only three frame joints are called for. This is one factor which enables the frame to be manufactured more cheaply than the frame of a conventional "safety" bicycle, a further factor being that less metal is used in the frame of the bicycle according to the invention.

Moreover the fact that less metal is employed in the frame of the bicycle according to the invention in conjunction with the fact that its small wheels are lighter than those of a conventional "safety" bicycle enables it to have an overall weight which is considerably less than that of a similarly equipped conventional bicycle.

Referring now to Figures 4 and 5, where a preferred form of front suspension system is shown in detail, it will be seen that the structure 52 is formed of a generally U-shaped member 52a and a pair of rod members 52b one on each side of the front wheel 11, the members 52a and 52b being connected to one another by a fabricated bracket member generally designated 53 pivotally carried by the bearing 51. The bend of the U-shaped member 52a embraces the tyre of the wheel 11 and bears against the spring 55. The legs of the U-shaped member 52a pass on each side of the wheel towards the spindle 10 with which they are associated by end plates 54 to which they are attached. The end plates 54 are each formed with notches 54a in which the wheel spindle 10 is adapted to be located by a locking device of known kind (not shown). The rod members 52b are each attached at one end to the end plate member 54 on that side of the wheel and at the other end to the bracket 53. A calliper brake assembly of known kind and generally designated 56 is also carried by the member 53, thereby ensuring that at all times the brake pads will be correctly positioned to engage the rim of the wheel.

The rubber spring 55 is of general wedge form in side elevation and is bonded between metal plates 55a and 55b, the former being attached to the U-shaped member 52a and the latter to the arcuate member 50. When the wheel encounters a surface inequality the leading arm structure pivots about the bearing 51 and the spring 55 is deflected in compression. The full bump, static and rebound positions of the suspension are shown at x, y and z respectively.

The arrangement of the rear wheel suspension system shown in Figures 6 and 7 comprises a fabricated bracket member generally designated 63 pivotally carried by the bearing 61 mounted at the rear end of the backbone

1. The trailing arm structure comprises a U-shaped member 62a with its legs connected to end plate members 64 and with its bend bears against the spring 65, said structure also including a rod member 62b on either side of the wheel and connected between the bracket member 63 and the end plate member 64 which latter is provided with a notch 64a in which the wheel spindle 12 is adapted to be located by a lock nut, one on each side (not shown). The U-shaped member 62a is also attached to the bracket member 63. The rubber 65 is again a generally wedge-shaped rubber block bonded between plates 65a and 65b the former attached to the U-shaped member 62a and the latter to a plate 67 attached to the backbone 1. A calliper brake assembly of known kind and generally designated 66 is carried by the bracket member 63, thereby ensuring that at all times the brake pads will be correctly positioned to engage the rim of the wheel.

The rear suspension arrangement operates generally in the same manner as the front suspension described above and the full bump, static and rebound positions of the suspension are shown at x, y and z respectively.

It is desirable that the distance of the spindle 12 from the pedal crank axle should not vary greatly during the working of the suspension in order to avoid undesirable changes in the tension of the driving chain. Accordingly the bearing 61 is so positioned that it is approximately on the line (when viewed in side elevation) between the pedal crank axle journal and the rear wheel spindle.

Regarding the front and rear suspension arm structures 52 or 62, each structure is rigid in itself to its triangulated form; it has a single wide pivot to guide the wheel firmly, and a single compression spring preferably of rubber. The arrangement of the rear suspension allows the removal of the driving chain or belt without splitting, and is advantageously strong where the machine is motor-driven.

It has been found that contrary to widely held beliefs a tyre of comparatively small overall diameter can be made which has a similar rolling resistance on normal roads to a tyre of conventional overall diameter, while as such a small tyre and its wheel are considerably lighter than a conventionally sized tyred wheel and therefore have less inertia, pedal thrust is more economically utilised in a bicycle according to the present invention.

As regards gearing, this will be similar to that of a similarly equipped conventional bicycle. Thus preferably with a 16 inch rear wheel, a rear sprocket having 14 teeth will be provided in conjunction with a chain wheel say having 52 teeth to give a 60 inch gear (i.e. a gearing producing say 188 inches of forward movement of the machine for one revolution of the pedals). A conventional three or four speed changeable hub gear or a "derailleur" gear may be provided.

In Figure 8 a simplified embodiment of a bicycle according to the invention is illustrated, in which while the arrangement is otherwise similar to that of the embodiment illustrated in Figure 2, the front and rear wheels are not resiliently supported. Instead the spindle 10 of the front wheel 11 is carried on forks 14 depending from a 'crown' 9 mounted at the lower end of the steering column 6, while the spindle 12 of the rear wheel 13 is carried on forks 15 extending rearwardly from and rigidly mounted on the rear end of the backbone 1.

Referring now to Figure 9 a bicycle according to the invention of the kind described with reference to Figure 2 is illustrated equipped with a number of accessories. The mudguards 100 and 101 provided for the wheels can either be fixed to the frame or arranged to move with the wheels during the working of the suspension. A fixed front cowl 102 may be provided which may have a generally concave space 104 at its rear whose mouth is covered by netting 103, said space being suitable for the carriage of small luggage articles. Weather protection for the rider may be improved by the provision of a cape (not shown) whose front end will suitably be fixed to the top of the cowl and which is adapted to be folded away within the space 104. A generator for a lighting system may be provided at 105 or 106 or a hub-dynamo may be employed. The lighting system may comprise a front lamp suitably fixed in any of the positions indicated at 107 and a rear lamp suitably fixed at either of the positions indicated at 108.

The rear carrying platform 33 is preferably of tubular construction and a large container 113 may be carried thereon. 116 represents a prop which may be folded up alongside the trailing arm 62 while a tyre pump 117 will suitably be located in known manner on the underside of the backbone 1. As will be seen from this Figure comparatively large areas suitable for carrying luggage for example at 104 and 113, are provided within the overall configuration of a bicycle according to the invention, while due also to the comparative smallness of the wheels and the relatively large space between the rear of the front wheel and the rider's feet when pedalling, adequate weather protection for the rider can be provided for example by the cowl 102 which extends from the handlebars 7 almost to ground level. Such a cowl has been shown under test to reduce the wind resistance of the rider and the bicycle. These and other advantages of a bicycle according to the invention as compared with a conventional "safety" bicycle will be apparent.

WHAT WE CLAIM IS:—

1. A two wheeled pedal cycle having a conventional layout as hereinbefore defined and

1. The trailing arm structure comprises a U-shaped member 62a with its legs connected to end plate members 64 and with its bend bears against the spring 65, said structure also including a rod member 62b on either side of the wheel and connected between the bracket member 63 and the end plate member 64 which latter is provided with a notch 64a in which the wheel spindle 12 is adapted to be located by a lock nut, one on each side (not shown). The U-shaped member 62a is also attached to the bracket member 63. The rubber 65 is again a generally wedge-shaped rubber block bonded between plates 65a and 65b the former attached to the U-shaped member 62a and the latter to a plate 67 attached to the backbone 1. A calliper brake assembly of known kind and generally designated 66 is carried by the bracket member 63, thereby ensuring that at all times the brake pads will be correctly positioned to engage the rim of the wheel.

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It is desirable that the distance of the spindle 12 from the pedal crank axle should not vary greatly during the working of the suspension in order to avoid undesirable changes in the tension of the driving chain. Accordingly the bearing 61 is so positioned that it is approximately on the line (when viewed in side elevation) between the pedal crank axle journal and the rear wheel spindle.

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It has been found that contrary to widely held beliefs a tyre of comparatively small overall diameter can be made which has a similar rolling resistance on normal roads to a tyre of conventional overall diameter, while as such a small tyre and its wheel are considerably lighter than a conventionally sized tyred wheel and therefore have less inertia, pedal thrust is more economically utilised in a bicycle according to the present invention.

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WHAT WE CLAIM IS:—

1. A two wheeled pedal cycle having a conventional layout as hereinbefore defined and

providing a conventional riding position for an adult rider and which has front and rear rubber tyred wheels, each of an overall diameter of between 12 and 19 inches, and a frame comprising a substantially straight main frame member extending rearwardly from a point above the front wheel towards the rear wheel, said main frame member having upstanding substantially at right angles from its front end a post member housing a steering column and surmounted by handlebars, and from a point intermediate of its length and immediately above a housing for a pedal crank axle which housing is located directly at the underside of the backbone and in contact therewith a seat tube surmounted by a saddle, said post member and said seat tube being of a length equal to at least half the distance between them and being joined at their lower ends to said main frame member to form a frame of open F-shape.

2. A two wheeled pedal cycle according to Claim 1, wherein the F-shaped frame is resiliently supported on the front and rear wheels by means including, for mounting the spindle of each wheel, a fork connected to the frame for relative springing movement and a rubber spring bearing on the fork structure associated with each wheel and adapted resiliently to resist upward movement of the associated wheel relative to the frame.

3. A two wheeled pedal cycle vehicle according to claim 2 wherein a mudguard assembly and/or a calliper brake assembly is/are carried on the fork structure supporting the wheel spindle.

4. A two wheeled pedal cycle vehicle according to Claim 1 wherein the main frame member is tubular, its cross section being that of a flat sided oval with its major axis vertical.

5. A two wheeled pedal cycle vehicle according to claim 1, wherein the post member and the seat tube member and the main frame member are tubular and are connected together by lugless joints, the lower end of the seat tube being manipulated at its junction with the main frame member and the front end of the latter being manipulated at its junction with the post member.

6. A two wheeled pedal cycle vehicle according to either of the preceding claims 1 or 2, wherein the main frame member terminates at a point ahead of the rear wheel whose spindle is carried on a fork structure which trails from a transverse pivot on the main frame member near its rear end and in rear of the pedal crank axle housing, there being rubber spring means arranged to bear on both the main frame member and the fork structure and controlling pivotal movement of the structure relative to the member.

7. A two wheeled pedal cycle vehicle according to claim 1, wherein the main frame member terminates at a point ahead of the rear wheel and provides a mounting for a resilient suspension for the driven rear wheel.

8. A two wheeled pedal cycle vehicle according to claim 1, wherein the front wheel spindle is carried at the front end of a forwardly extending fork structure which latter is arranged for resilient springing movement relative to the frame.

9. A two wheeled pedal cycle vehicle according to claim 1, wherein the seat tube and the housing for the pedal crank axle are so joined to the main frame member that the latter is not pierced or apertured at the junctions.

10. A two wheeled pedal cycle vehicle according to claim 9, wherein the post member and the seat tube, upstanding from the main frame member, taper upwardly and are each terminated at approximately the same height from the ground.

11. A two wheeled pedal cycle vehicle according to claim 1, including a tubular member extending forwardly from the seat tube to join the main frame member, said tubular member serving as a carrying handle located at the point of balance of the machine when it is lifted.

12. A two wheeled pedal cycle vehicle according to any of the preceding claims wherein the vehicle has conventional gearing for a pedal cycle, that is a gear of between say 50 and 80 inches and/or the gearing being variable in known manner by either a 'derailleur' mechanism or by a hub gear box.

13. A two wheeled pedal cycle vehicle according to claim 6, wherein the housing for the pedal crank axle, the transverse pivot and the rear wheel spindle are substantially in the same straight line when viewed in side elevation.

14. A two wheeled pedal cycle vehicle having front and rear rubber tyred wheels of an overall diameter of between 12 and 19 inches and a frame including a single straight longitudinal tubular main frame member or backbone forming a connection between the front and rear wheels of the vehicle and extending from a point above the front wheel towards the rear wheel, the frame including also a pair of tubular members extending upwardly substantially at right angles from the backbone, one of said tubular members having its lower end fixed to the backbone at a point above the front wheel and forming a housing for a steering column supporting the front wheel and surmounted by handlebars, while the other of said tubular members, which is surmounted by a saddle has its lower end fixed to the backbone at a point intermediate of the length of the latter and above a housing for a pedal crank axle located at the underside of the backbone and in contact therewith.

15. A two wheeled pedal cycle vehicle according to claim 14 wherein the backbone terminates at a point ahead of the rear wheel, there being near the rear end of the backbone

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and in rear of the pedal crank axle housing, a transverse pivot on which is mounted a trailing arm structure carrying the rear wheel with spring means operating between the backbone and the arm structure resiliently to control pivotal movement of the arm structure relative to the backbone.

16. A two wheeled pedal cycle vehicle having wheels of small diameter and an open F-shaped frame substantially as described with reference to Figure 1 of the Accompanying drawings.

17. A two wheeled pedal cycle vehicle constructed and arranged substantially as described with reference to any of Figures 2 to 9 of the accompanying drawings.

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PROVISIONAL SPECIFICATION

No. 38781 A.D. 1959

Improvements in Pedal Cycles

We, MOULTON CONSULTANTS LIMITED, a Body Corporate duly organised under the Laws of Great Britain, of The Hall, Bradford-on-Avon, Wiltshire, do hereby declare this invention to be described in the following statement:—

This invention relates to bicycles and whilst applicable particularly to pedal cycles is also applicable to motorised bicycles and has for its object to provide a bicycle which may be ridden equally well by male and female riders and which is of simple yet very strong and economical construction, of very light weight, having a lower overall length than a normal cycle without sacrifice of operating efficiency, yet providing more space for the carriage of parcels and the like without overhang, than is possible with the known forms of bicycle.

It has now been found that contrary to widely held beliefs a tyre of comparatively small overall diameter can be made which has similar rolling resistance on normal roads to a tyre of the conventional overall diameter. The present invention utilizes this discovery.

According to the invention a pedal cycle or moped (i.e. excluding scooters etc.) for adults (i.e. excluding fairy cycles) having an arrangement which maintains the relative dispositions of handle bars, seat, crank-throw, ground clearance and wheelbase, (known from the classical arrangement of these elements in a bicycle for adults), essentially includes a pair of small wheels (overall wheel diameter of 14″—18″ as opposed to the overall wheel diameter of 24″—28″ used on a conventional bicycle) spaced apart so as to provide the conventional wheelbase of 40—44 inches, a tubular backbone or beam of substantially larger diameter than that of the frame tubes employed on normal bicycles, said beam extending from the crown (i.e. a point, not more than say 3 inches above the juncture of the front forks which carry the front wheel, and not more than say 6 inches above the wheel tread) substantially in a straight line towards the rear wheel spindle, said beam being forked to mount said rear wheel spindle; a steering post comprising a tube, which may be tapered, extending upwardly substantially at right angles to and adjoining said beam at a point directly above said front fork juncture, said tube carrying the steering head and having at its upper end the handle bars; a second tube which may be tapered extending upwardly substantially at right angles to and adjoining said beam at a point between 15 and 20 inches from the rear wheel spindle, said tube forming a saddle post; a bottom bracket or housing for the crank journal which latter is located say 15—20 inches from the rear wheel spindle and positioned close to the underside of the beam.

Preferably the posts taper from their junction with the main beam to their upper ends. The main tubular beam, which is of larger diameter than conventional cycle frame tubes not only provides the requisite strength to support vertical loads as a beam but also provides higher torsional rigidity to withstand high pedal thrusts than that of the small tube diamond frame employed in conventional bicycles.

A saddle is adjustably mounted preferably by means of a wing nut operated clamp in the upper end of the saddle post and a steering column which may be generally of known form passes through the steering post to control the front wheel. Such steering post may have a small centreing spring operating between the rotating steering column and the fixed steering post.

The rear wheel is mounted in forks projecting rearwardly from the rear end of the main beam and is driven by substantially standard chain and sprocket mechanism the main pedal chain wheel being mounted in the bottom bracket or pedal box which is secured close to the underside of the main beam at the normal height from the ground of 10—11 inches. The disposition and sizes of the chain wheel and sprocket are such that the "gearing" is normal and the lower run of the drive chain is horizontal and the upper run parallel with and close to the forks thereby reducing offset loads. If desired, the usual three speed gearbox may be incorporated in the rear wheel hub. Caliper brakes are fitted and, if desired, a carrier may be permanently or removably secured to the rear forks and situated so as to project rearwardly above the rear wheel.

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The spindle of the rear wheel is so disposed that the periphery of the wheel always lies behind the saddle post and, consequently, there is a space behind said post to a distance at least equal to the diameter of the rear wheel to support parcels without overhang. The front wheel is spring mounted in a front fork journalled in the lower end of the steering post, and caliper brakes are also fitted to the front wheel. In order that such brakes always properly engage the wheel rim, the wheel is mounted by a spring suspension device.

The brake cables and the gearbox control cable, together with lighting cables are enclosed and may all be housed within the tubular members of the frame.

A parcel bracket may be permanently or removably secured to the steering post and extend forwardly to a distance at least equal to the radius of the wheel without overhang and it will be quite clear that a space of much greater depth is thus provided for carrying of parcels and other articles.

Suitable fairings are provided for the front and rear wheels and by reason of the arrangement and the small size of the front wheel the front fairing may be permanently secured to the main beam or steering post, thus dispensing with the usual type of mudguard which moves with the front wheel.

A carrying handle may be provided at the junction of the main beam and saddle post, at the point of balance of the cycle, which handle also serves as a reinforcing tie.

In assembling the frame, the saddle post, which also is of larger diameter than its counterpart on a conventional bicycle, is contoured at its root partly to embrace the main beam and the main beam is contoured at its front end partly to embrace the steering post the tubes being welded, for example gas or arc welded, around their junction lines.

By providing a frame of large diameter tubes, it will be understood that lower quality tubing and of heavier gauge may be employed without sacrifice of strength and that it is readily possible due to the larger surface area to provide improved finish of the frame by painting in decorative style as compared with conventional bicycles.

The use of the small wheels of the range of sizes already specified, in conjunction with a wheel base of about 42" (which wheelbase is normal for a conventional bicycle and has been retained in the present invention to ensure safety and stability during braking on hills) provides the following features:—

(a) a substantial gap between the toe of the rider's foot on the forward pedal stroke and the rear part of the front tyre.

(b) a narrow width of the front wheel when viewed in plan when on the full steering lock of say 35°.

(c) the projection of the forward edge of the front tyre in front of the steering post is limited.

The conjunction of these three features indigenous with use of the small wheel enables one to provide alternatively

(1) a fixed leg shield stretching from below the handle bars to just above ground level at a substantial width.

(2) a forwardly extending substantially horizontal platform integral with the mud guard platform.

(3) a shaped front enclosure ahead of the edge of the front wheel for streamlining and luggage carrying.

(4) the stowage of an electric storage battery for an electrically driven or assisted machine.

It will also be appreciated that the main tubular member may be in two parts with a suitable connecting spigot where the bicycle is to be foldable or collapsible.

A bicycle according to the invention thus presents many advantages, the most important of which may be summarized as follows:—

1. The large diameter of the tubes allows easy welding of the joints. Three frame welds are employed on a bicycle according to the present invention as opposed to eight on a conventional bicycle.

2. Reduction in overall length by as much as 1ft. is achieved over that of a conventional bicycle. The length will be less than the width of an average car ensuring ease of transport on the bumpers thereof.

3. A weight reduction of 10 lbs. approximately as against a conventional bicycle similarly equipped is achieved.

4. Increased carrying capacity within the contour or overall silhouette of the cycle is achieved.

5. It is easy to get on or off by both sexes. It has a low 'step-over' height.

6. All cables are enclosed within the tubes. There is no need for the outer sleeve of a Bowden wire as the tubes themselves may perform the function of the outer sleeve.

7. It has large surfaces suitable for painting aesthetically or flamboyantly.

8. It has possibilities of very good weather protection for the rider. Skirts, capes etc., can be provided which can be attached to the fixed mudguards

9. It may include a combined rear mudguard and chain guard and carrier support which is much less flimsy than previous ones. Due to the small wheels the front mudguard may be fixed to the main frame.

10. The small wheels make the centre of gravity of the bicycle lower; it is more easy to ride slowly.

11. Straight arm lifting is possible as the carrying handle is at or above the centre of gravity.

12. The small wheels make for more manoeuvrability when carried.

13. The beam has sufficient strength to accommodate all normal vertical loads.

14. Great torsional stiffness for the alternating pedal thrust is obtained by the large diameters of the tubes and the proximity of the chain line to the rear fork line, and the closeness of the bottom bracket to the underside of the beam which is torsionally very stiff.

15. The small wheels render possible the use of a motor cycle type stand (moving radially round the rear wheel spindle).

16. The stowage of an internal combustion motor or an electric battery and motor can be readily achieved due to the space provided by virtue of the design.

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PROVISIONAL SPECIFICATION

No. 7572 A.D. 1960

Improvements in Pedal Cycles

We, MOULTON CONSULTANTS LIMITED, a Body Corporate duly organised under the Laws of Great Britain, of The Hall, Bradford-on-Avon, Wiltshire, do hereby declare this invention to be described in the following statement:—

This invention relates to bicycles such as pedal cycles and motorised bicycles.

In the Specification of co-pending Patent Application No. 38781/59 there is described a pedal cycle or moped (i.e. excluding scooters etc.) for adults (i.e. excluding fairy cycles) having an arrangement which maintains the relative dispositions of handle bars, seat, crank-throw, bottom bracket height, ground clearance and wheelbase, (known from the classical arrangement of these elements in a bicycle for adults), and which essentially includes a pair of small wheels (overall wheel diameter of 14"—19" as opposed to the overall wheel diameter of 24"—28" used on a conventional bicycle) spaced apart so as to provide the conventional wheelbase of 40—45 inches, a tubular backbone or beam of substantially larger diameter than that of the frame tubes employed on normal bicycles, said beam extending from the crown (i.e. a point, not more than say 3 inches above the front fork assembly and/or not more than say 6 inches above the wheel tread) substantially in a straight line towards the rear wheel spindle, a steering post comprising a tube, which may be tapered, extending upwardly substantially at right angles to and adjoining said beam at a point above said front fork assembly, said tube carrying the steering head and having at its upper end the handle bars; a second tube extending upwardly substantially at right angles to and adjoining said beam at a point between 15 and 20 inches from the rear wheel spindle, said tube forming a saddle post; a bottom bracket or housing for the crank journal which latter is located say 15—20 inches from the rear wheel spindle and positioned very close to the underside of the beam.

It has now been found that the tubular backbone may either take the form of a single beam or alternatively a cluster or plurality of small diameter tubes may be employed. The backbone may also be formed of two sections adapted to be taken apart to enable the bicycle to be collapsed to facilitate transporation. The tube or tubes constituting such backbone may be formed of any suitable metal but preferably either a large diameter light gauge steel tube, or a tubular construction of pressed steel components, or a light alloy extrusion with 'Redux' (Registered Trade Mark) joints is employed. It has also been found that the aesthetic appearance of a bicycle according to the invention may be enhanced if the backbone is radiused upwardly at its juncture with the steering post. This measure enables the length of the steering post to be reduced.

The present invention is concerned with further improvements in such small wheeled bicycles or mopeds, and according to one aspect provides spring syspension for both the front and rear wheels. Preferably both front and rear wheel suspensions are of the kind employing resilient rubber compression pads.

In the case of the front suspension, particularly where a fixed front mudguard or weather protector is provided mounted on the main frame of the bicycle, an arcuate structure depends from the bottom of the steering column behind the wheel following the curve of the tyre under the mudguard or weather shield. At its lower end there is fixed a transverse horizontal bearing to which is mounted a leading armstructure which carries the spindle or hub of the front wheel. Springing is provided by the interposition of a single spring, preferably rubber, between the arcuate member and the leading arm structure, so that the load upon the spring is multiplied by a high ratio of mechanical advantage, say 3—5:1. It will be understood that when the steering column is turned by movement of the handle bars, the arcuate structure turns with it and through the suspension arm structure steers the front wheel.

The suspension arm structure also mounts the caliper or other brakes (if fitted) engaging the rim of the front wheel. Alternatively drum brakes may be used with the back plate being anchored to the suspension arm structure.

The rear suspension is approximately by trailing arm.

Preferably, the suspension arm structure for both the front and rear suspension systems comprises for each wheel a pair of suspension arms bridged together to embrace the tyre and extending on either side of the wheel towards the wheel hub or spindle to which they are bolted. The arms are tri-angulated in side view, two of the apices of the tri-angulated arm at each side of each wheel being bridged together and to the corresponding apices of the arm on the opposite side of the wheel by a metal plate, to form a yoke structure embracing the tyre. Such metal plate is journalled at its lower end to the frame in respect of the rear wheel suspension, and to the arcuate structure depending from the steering column in the case of the front suspension arrangement. At its upper end such plate bears against a spring, suitably a rubber compression spring carried by the frame or the depending arcuate member as the case may be. The third apex of the tri-angulated arm at each side of the wheel is adjacent the mounting for the wheel hub or spindle.

The upper part of the rear wheel is masked by an improved form of rear mudguard or cowl, suitably of light gauge light alloy, moulded resin, bonded fibre glass or other synthetic resinous material, which is extended forwardly to form a chain guard over at least the top of the driving chain wheel.

The cowl is of generally inverted U-form of a width just sufficient to clear the rear wheel trailing arms and chain, and for lightness and appearance its lower edge may be inclined upwardly from a location in the vicinity of the end of the main frame where the rear wheel suspension arms are mounted to the rear end of the apron, these edges being reinforced in any appropriate manner as by beading with or without an inset of a metal tube or the like.

When mounted on the bicycle the rear cowl has a generally horizontal upper surface running rearwardly from just behind the saddle post to a point above the rear edge of the wheel, and as the level of this top surface of the apron, after allowing adequate clearance of the rear wheel in the full bump position of the suspension, is only some 16"—20" above the ground, a large free space is left above the cowl behind the saddle post for supplementary containers. The apron is preferably a load carrying structure, the upper inverted U-shaped edge being in tension under load and attached at its forward end to the saddle post, while the upwardly inclined lower edge is reinforced with a steel tube and is under compression when the cowl is loaded; at its forward end the lower edge is attached to the main beam or backbone of the bicycle and is reinforced by an upwardly inclined steel tube at its lower edge. The cowl is preferably formed of plastic but it may possibly be made of thin metallic sheet.

The invention provides for supplementary containers which may be generally rectangular in plan and elevation, but the bases of which are shaped and adapted for detachable securement to the upper edge of the inverted trough shaped cowl. Such containers will preferably be tapered in plan view to improve the aerodynamic form of the bicycle and rider.

Preferably there is also provided at the front of the bicycle, a fixed cowl for weather protection and to provide improved performance by reducing wind resistance, which may amount to 10% reduction in energy required even at moderate speeds.

This cowl will have a double curvature and will be tall and narrow, extending from a point just below the handle bars to a point about 6 inches above the ground. The handle bars will be mounted ahead and well clear of the cowl. At its lower part the cowl may be provided with a small forward extension covering the upper part of the tyre tread. The cowl may also be provided with an apron fixed to it, and which may be attached around the waist of the rider for added weather protection as described in the Specification of copending Application No. 42975/59.

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Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press (Leamington) Ltd.—1962. Published by The Patent Office, 25 Southampton Buildings, London, W.C.2, from which copies may be obtained.