No. 733,518. PATENTED JULY 14, 1903.

P. W. TILLINGHAST.

BICYCLE.

APPLICATION FILED JULY 13, 1896.

NO MODEL. 4 SHEETS—SHEET 1.

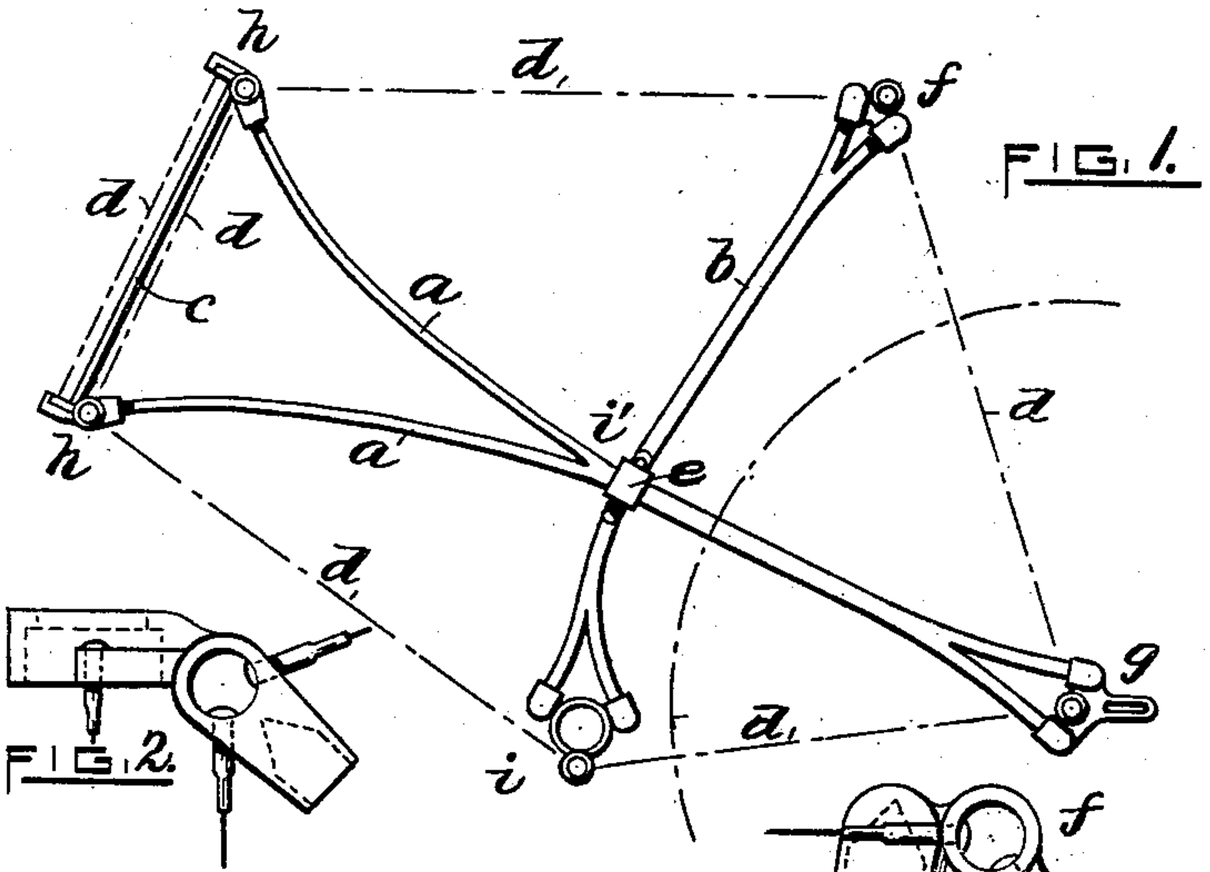

FIG. 1.

FIG. 2.

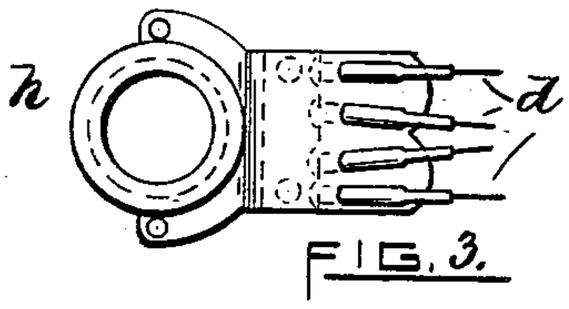

FIG. 3.

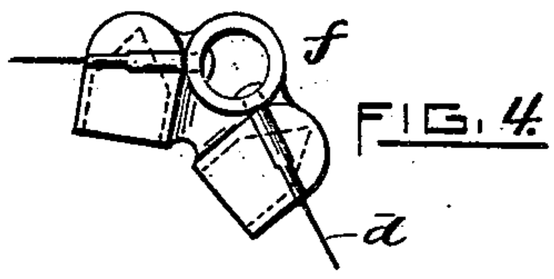

FIG. 4.

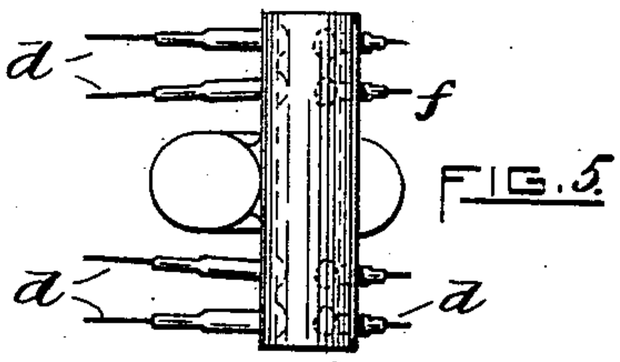

FIG. 5.

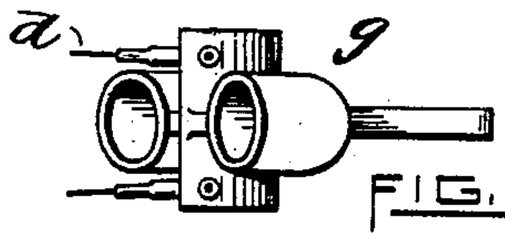

FIG. 7.

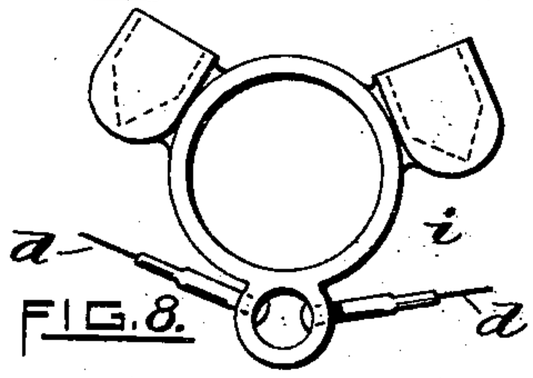

FIG. 8.

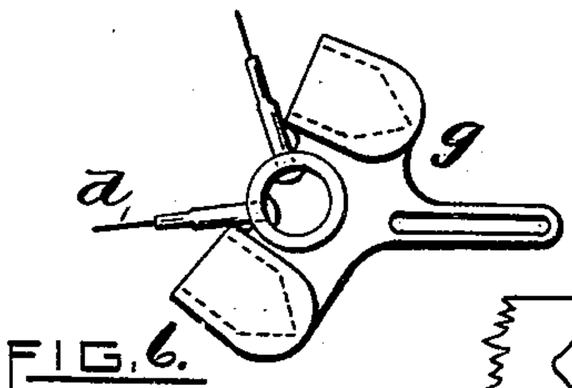

FIG. 6.

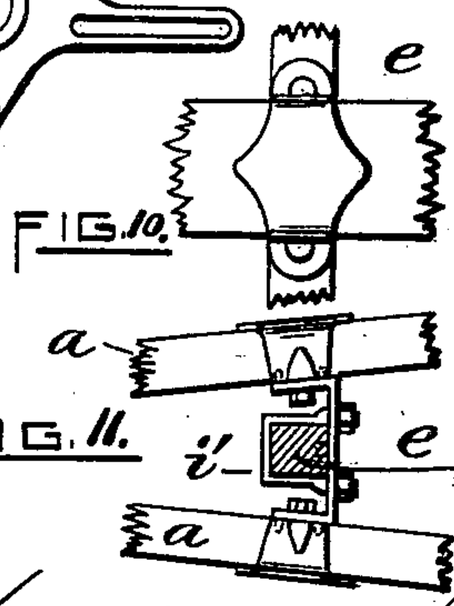

FIG. 10.

FIG. 11.

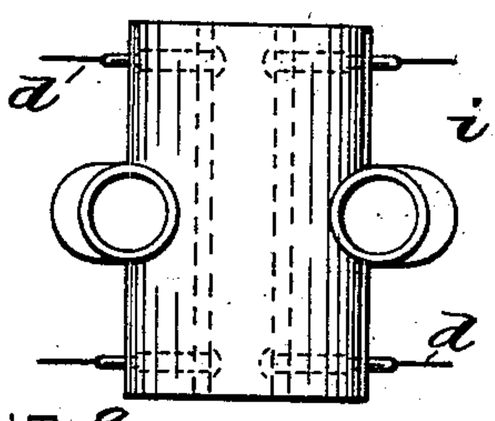

FIG. 9.

WITNESSES.

Charles T. Hannigan.

Anne E. Perce

INVENTOR,

Pardon W. Tillinghast

by his attorney,

Warren R. Pence

No. 733,518. PATENTED JULY 14, 1903.

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NO MODEL. 4 SHEETS—SHEET 2.

FIG. 12.

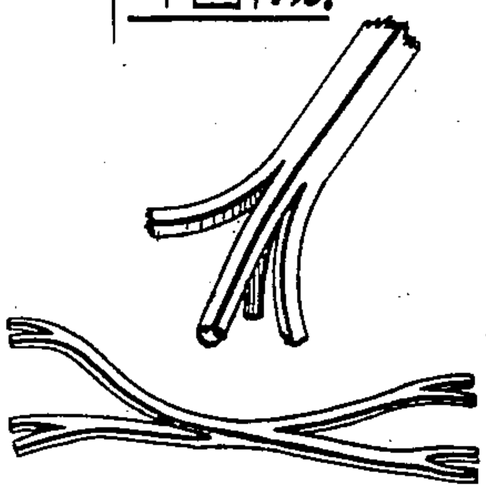


FIG. 13.

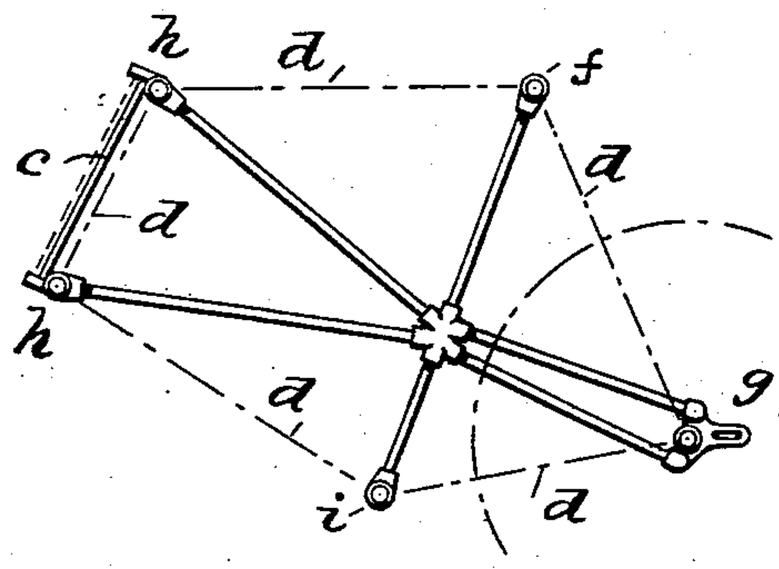


FIG. 14.

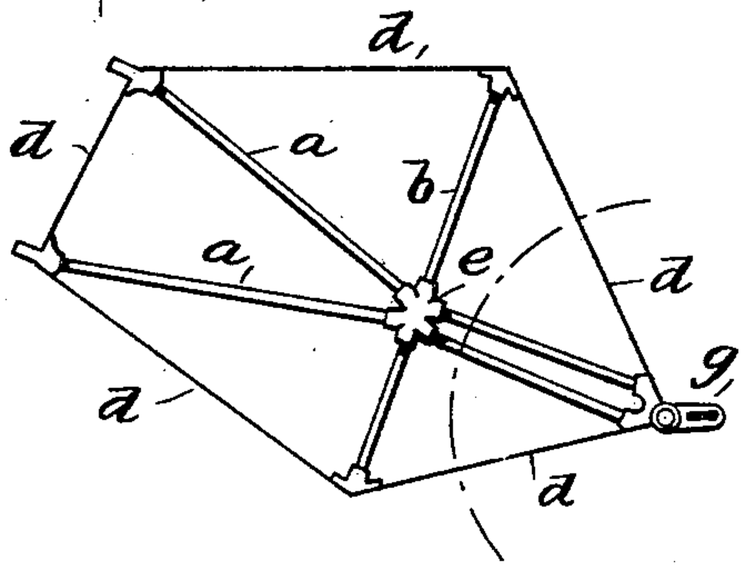


FIG. 15.

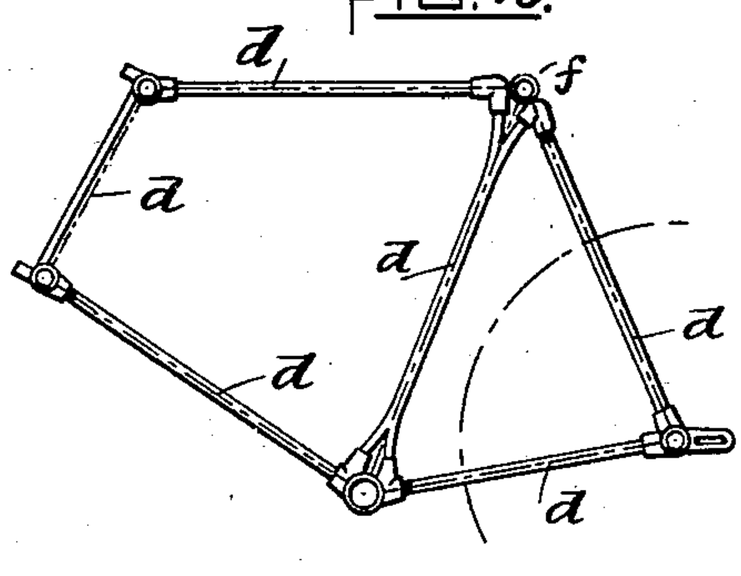


FIG. 16.

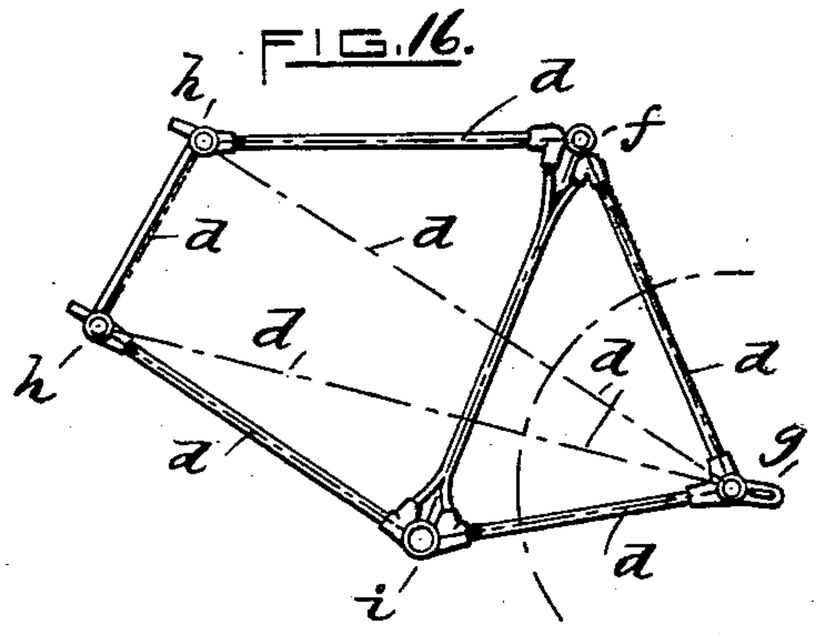
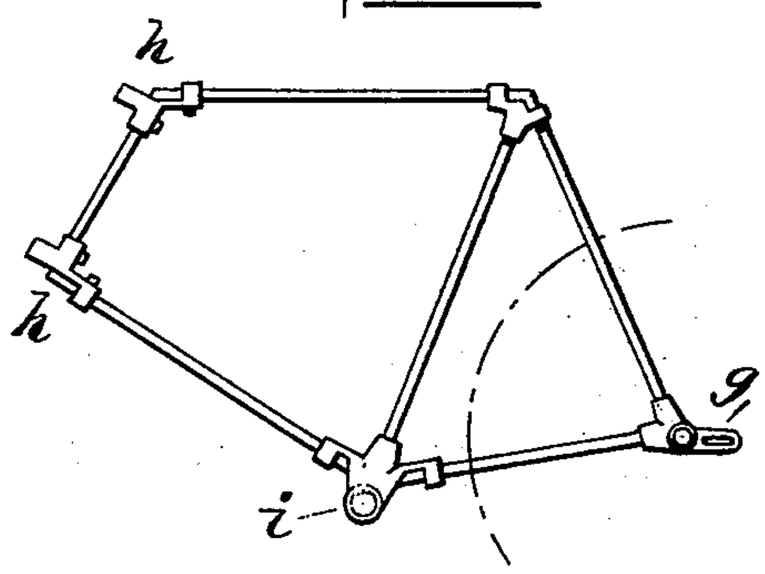


FIG. 17.



WITNESSES.

Charles I. Hamnigan.

Annie E. Pierce

INVENTOR.

Pardon W. Tillinghast

by his attorney

Warren R. Pierce

No. 733,518. PATENTED JULY 14, 1903.

P. W. TILLINGHAST.

BICYCLE.

APPLICATION FILED JULY 13, 1896

NO MODEL. 4 SHEETS—SHEET 3.

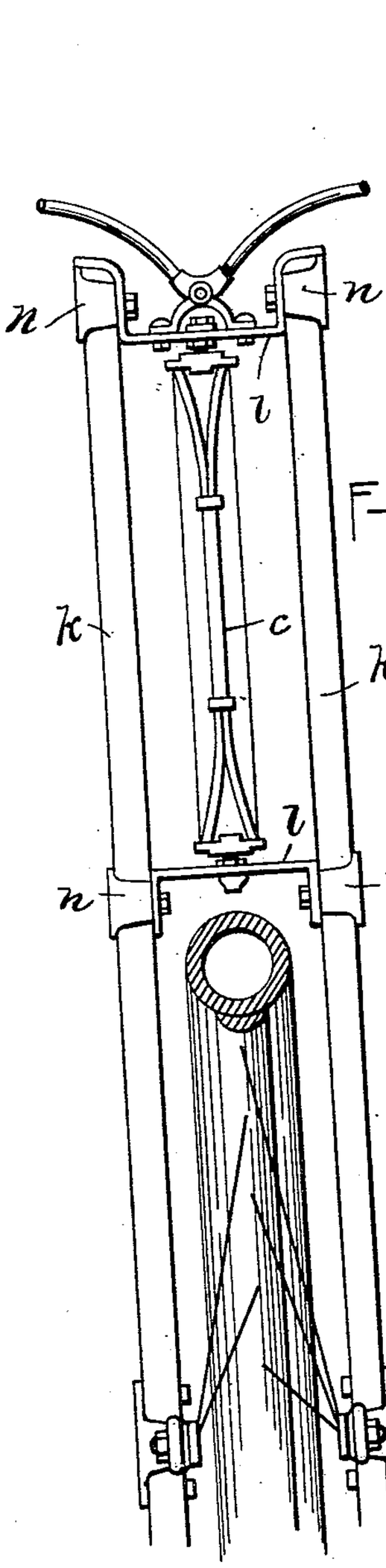


FIG. 18.

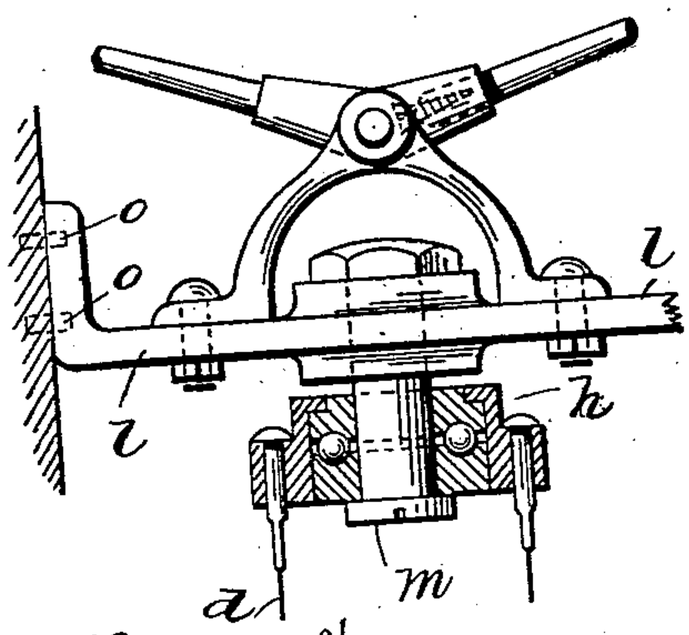


FIG. 19.

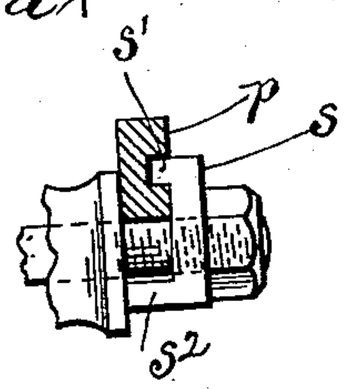


FIG. 21.

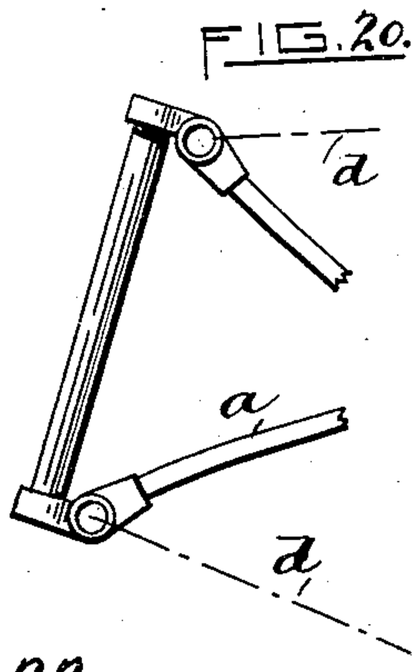


FIG. 20.

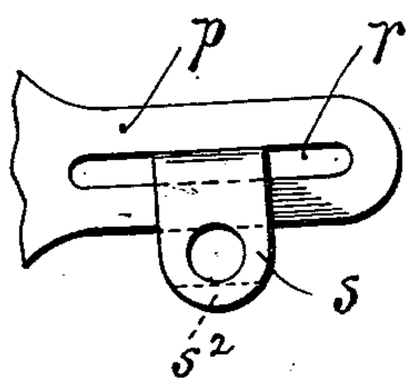


FIG. 22.

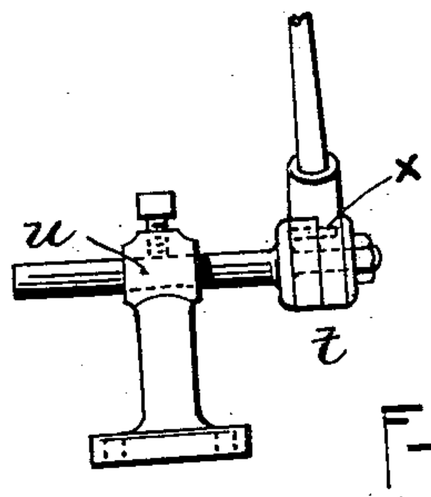


FIG. 23.

INVENTOR:

Witnesses:

Charles T. Hannigan

Annie E. Perce

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No. 733,518. PATENTED JULY 14, 1903.

P. W. TILLINGHAST.

BICYCLE.

APPLICATION FILED JULY 13, 1896.

NO MODEL. 4 SHEETS—SHEET 4.

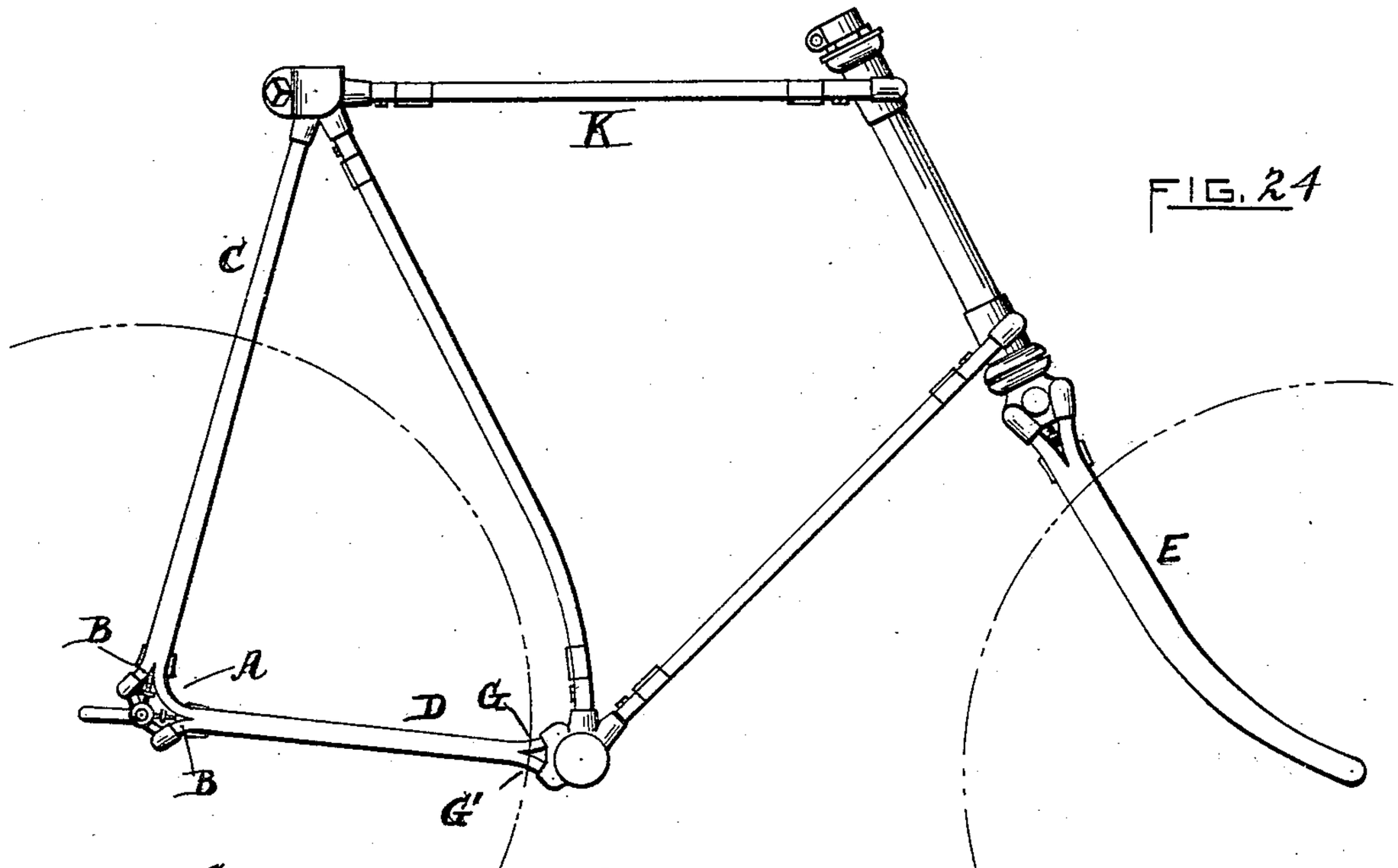

FIG. 24

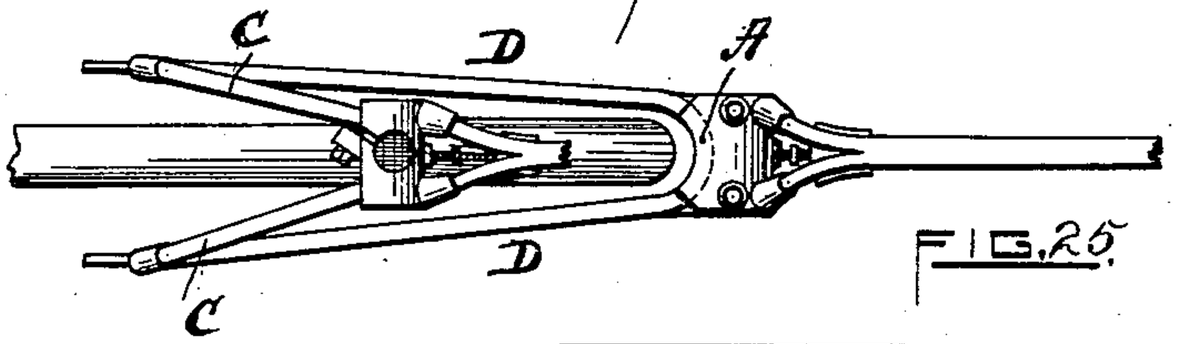

FIG. 25.

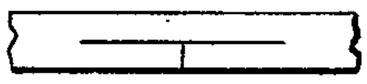

FIG. 31

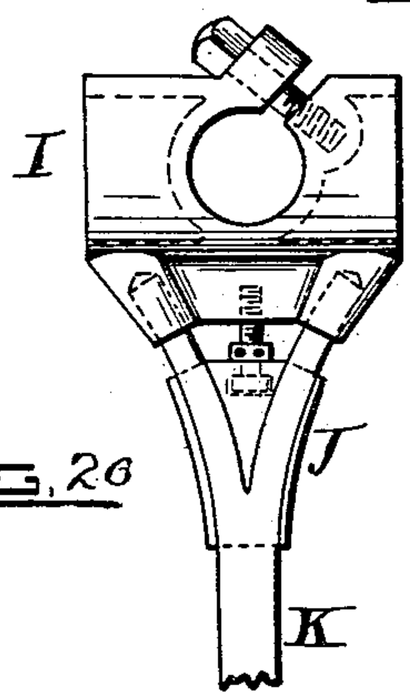

FIG. 26

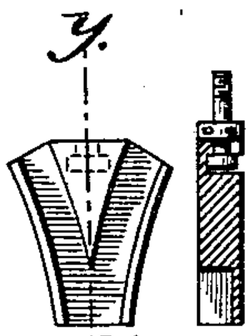

FIG. 27.

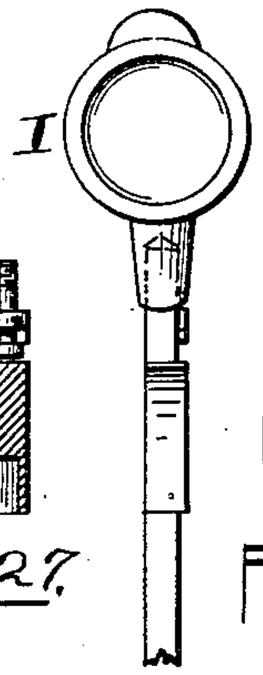

FIG 28

FIG. 29.

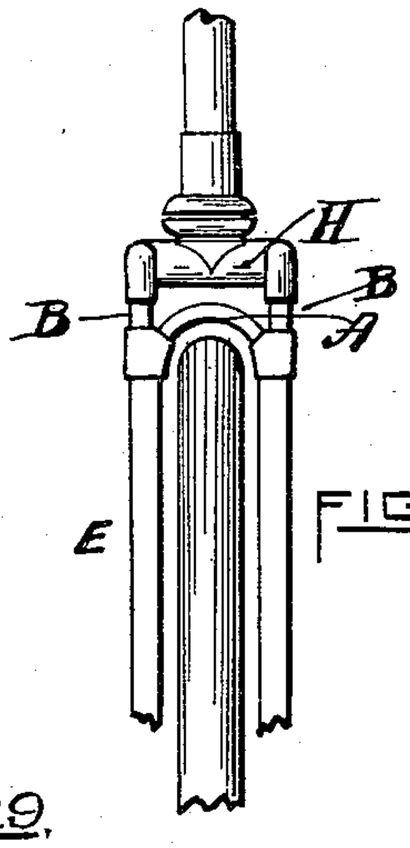

FIG. 30

Witnesses.

Charles T. Hannigan.

Annie E. Perce

Inventor.

Pardon W. Tillinghast

by his attorney

Warren R. Perce

No. 733,518. Patented July 14, 1903.

UNITED STATES PATENT OFFICE.

PARDON W. TILLINGHAST, OF PROVIDENCE, RHODE ISLAND.

BICYCLE.

SPECIFICATION forming part of Letters Patent No. 733,518, dated July 14, 1903.

Application filed July 13, 1896. Serial No. 599,006. (No model.)

To all whom it may concern:

Be it known that I, PARDON WILBUR TILLINGHAST, manufacturer, a citizen of the United States, and a resident of the city of Providence, in the county of Providence, in the State of Rhode Island, have invented certain new and useful Improvements in Bicycles; and I declare the following to be a specification thereof, reference being had to the accompanying drawings.

Like letters indicate like parts.

Figure 1 is a side elevation of my improved frame for bicycles. Fig. 2 is a side elevation of one of the combined frame-tips with its tube and bearings. Fig. 3 is a top plan view of the same. Fig. 4 is a side elevation of another of the frame-tips with the tube connected therewith. Fig. 5 is a top plan of the same. Fig. 6 is a side elevation of the rear bottom frame-tip, tube, and lug. Fig. 7 is a top plan view of the same. Fig. 8 is a side elevation of the lower frame-tip and tube. Fig. 9 is a top plan of the same. Fig. 10 is a side elevation of one of the clips used upon the frame. Fig. 11 is a sectional view of the central brace with the clips attached thereto. Fig. 12 is a perspective view of the ends of the struts to illustrate their forked form. Figs. 13, 14, 15, 16, and 17 show in side elevation modified forms of the frame. Fig. 18 is a front elevation of the steering-head. Fig. 19 shows the handle-bar in front elevation and one of the bearings in diametrical cross-section. Fig. 20 shows in side elevation a tubular steering-head in combination with my improved frame. Fig. 21 is a front elevation of a device to hold the rear wheel to the frame. Fig. 22 is a side elevation of the same. Fig. 23 is a side elevation of the handle-bar adjustment. Fig. 24 is a side elevation of the bicycle-frame to illustrate the bending of the struts and the mode of tightening the same in position. Fig. 25 is a top plan of the same. Figs. 26, 27, and 28 are views of the strut-tightening devices. Fig. 29 illustrates the clamping-screw. Fig. 30 is a front elevation of the fork. Fig. 31 illustrates the manner of cutting the wooden strut for the purpose of bending the same into the forms shown in Figs. 24 and 30.

My invention relates to the frame and steering-head of bicycles; and it consists in the combination of a frame of struts and tensional devices to form a truss, in making a steering-fork and steering-head by using two side pieces, substantially parallel, which extend from the front axle to the upper frame-bearing, with cross-pieces to join said side pieces, and providing means for the reception and holding of the forward end of the frame and in novel means of attaching the rear wheel to the frame.

The characteristic feature of my said improvements is the substitution of wooden parts for the usual metallic ones in order to diminish weight and reduce the cost. In order to accomplish this substitution successfully, the mode of construction must be greatly modified and many new elements or parts introduced. I use in this construction any suitable wood, preferably ash or hickory, which I make in strips of the necessary form and size and then steam them and bend and confine them in the required shapes until they are thoroughly dried. This process being well known in the treatment of wood needs no further description here.

In Fig. 1 I show one form of the frame, which is made of duplicate longitudinal struts *a*, extending from the rear axle to the steering-head. The forward end of each strut *a* is split or bifurcated to a considerable extent and spread, as illustrated in Fig. 1, and the rear end is also bifurcated and spread, but to a much less extent, as there shown. A cross-strut *b* extends from the crank-axle to the saddle and has its ends bifurcated and spread, as seen in Fig. 1. The strut *b* passes between the struts *a a* and is centrally secured in position, as shown in detail in Fig. 11, by means of a clip bolted to a cross-brace. Said brace is bolted to the struts *a a* on the inner side thereof, and the clips, passing over said struts, are fastened to the cross-brace. The front strut or bar *c* serves to keep the forward bent ends of the struts *a a* extended, as fully seen in Fig. 1, which ends form a backing for the bearings at the steering-head. The ends of the strut *c* are bifurcated and spread, as shown in Fig. 18.

Suitable metallic tips are used at the ends of the struts *a* and *b*, which extend crosswise of the struts at the ends thereof and laterally therefrom. At the forward ends of the struts

a are the tips *h*, as shown in side elevation in Fig. 2 and in top plan in Fig. 3, where it is seen that they each have a centrally-open tubular socket adapted by flanges to receive the upper cone-bearing, (see Figs. 3, 18, and 19,) in combination with a connecting-piece or cross-head having sockets adapted to receive the ends of the struts *a*. Said tips *h* extend crosswise of the struts *a* and extend laterally therefrom. This lateral extending of the tips for the ends of the struts gives a lateral bracing and stiffens the frame. The strut-receiving sockets have recesses, Fig. 2, substantially straight at their inner sides and tapering bottoms. The tapering form of the bottoms of the recesses in the sockets serves to accurately center the struts in the sockets and causes the bearing to come on the ends of the struts and to hold them securely from movement, while the straight inner sides of the sockets serve to materially strengthen the frame. The tapering of the sockets may be round or with flat sides. This latter construction will serve to prevent a wringing or twisting movement and will make a stiffer frame. The tip *h* has a flange through which it is secured to the strut *c* by pins or screws, as seen in Figs. 2 and 19. Between the socket for the upper cone-bearing and the sockets for the struts *a* is a laterally-extending tube or cross-head, the purpose of which is to furnish suitable means for the engagement of the tensional device. The tubes or cross-heads are preferably made a part of the metal tips at the several ends of the struts. I prefer to have but one tube or cross-head on each tip at the angles of the frame.

At the rear ends of the strut *a* is the frame-tip *g*. (Shown in top plan in Fig. 7 and in side elevation in Fig. 6.) The tip *g* also has a tube or cross-head, two sockets for the reception of the rear ends of the strut *a*, together with a slotted extension or lug *p*, extending rearward. (See Fig. 22.)

At the upper end of the strut *b* is the frame-tip *f*, (shown in side elevation in Fig. 4 and a top plan in Fig. 5,) and comprising a tube or cross-head and sockets, as there appears.

At the lower end of the strut *b* is the frame-tip *i*. (Shown in side elevation in Fig. 8 and in top plan in Fig. 9.) It has sockets, a tube or cross-head for the tensional devices, and also a large tubular bearing for the crank-axle.

A two-inch separation of the rear ends of the struts *a* has been found to be sufficient to brace the angles of the frame at that point, and about the same separation is required at the lower ends of the struts *b*, while the separation of the upper ends of the struts *b* is preferably somewhat less in extent. The degree of separation of the forked ends of the struts *b* and *c* is governed by the width of the central brace or bracket and the frame-tips *f* and *h*.

The tensional device is designed to brace the struts, and it consists of wires *d*, preferably headed at one end and screw-threaded at the opposite end, like the wire spokes used in the manufacture of bicycle-wheels. The threaded end of the wire is screwed into a nipple having a screw-threaded bore and made with a head, the head being inside the tubular cross-head, as shown, so that the nipple projects through a hole in such cross-head and extends outwardly. The headed ends of the wires *d* are inside the tubular portion or cross-head of the several metallic frame-tips. Said wires *d* extend from tip to tip. Each wire *d* thus constitutes a truss or brace, which makes the frame extremely rigid. Instead of a single wire from tip to tip I prefer to employ a set of four, (see Figs. 3 and 5,) and thus take advantage of the width of the frame at the several tips. The tubes or cross-heads should have a wall sufficiently thick to withstand the strain exerted by the pull of the tension-wires *d*. It is a feature of my invention that I make these struts with bifurcated ends or with quadripointed ends, Fig. 12, which impart great rigidity to the frame and at the same time allow the use of a much lighter stick than could otherwise be safely employed.

The forking of the struts *b* and *c* is more desirable than joining them to the tips in single sockets. The separation of the ends serves to brace the frame-angles and, together with the tensional devices, pulling from a substantially central point, throws all strain onto the ends of the forks and prevents a tendency of the tips to turn or wring over the ends of the struts, which is very noticeable and dangerous when single sockets and plain struts are used.

The upright strut *b* is bifurcated both at its upper and lower ends to better enable it to intercept the strain transmitted to the tips *f* and *i* by the weight of the rider and the application of the propelling power. Instead, however, of making the struts with bifurcated ends a larger number can be used singly and suitably joined.

Fig. 13 illustrates a modification in which the struts radiate from a common center. I prefer to carry two struts to each angle of the frame and brace the whole in a similar manner to the frame shown in Fig. 1. Another construction varying slightly from this frame is shown in Fig. 14. The struts may be likened to the spokes in a carriage-wheel, radiating from a common center or hub, and are braced by shrinking a band or bands onto and over the ends of the spoke in the manner employed by wheelwrights in setting a tire.

The bracing of the frame may be varied and keep within the scope of the invention. Instead of using separate tensional devices between the angles of the frame a set of wires may entirely encircle the struts, touching the angles of the frame, and be provided with means for tightening the wires to stiffen the frame.

Fig. 15 shows a further modification of the invention. In this construction the struts are preferably carried in a direct line from angle to angle of the frame, at which point suitable sockets and connections are provided, and the whole is braced, as in Fig. 1, by tension-wires extending from angle to angle substantially encircling the frame. The frame is further strengthened by tension-wires from the top to the bottom of the central vertical strut. The same struts may be used in connection with the bracing. (Illustrated in Fig. 16.)

Another form of frame analogous to a carriage-wheel and within the scope of my invention is illustrated in Fig. 17. A wood felly or rim portion is employed, preferably of the form shown, which may be a continuous piece or one or more pieces joined. The rear may be forked to receive the wheel, or two felly-pieces may be used side by side. An upright is used from the saddle to the crank-axle, and the felly may be braced with truss-wire from angle to angle, as shown in Figs. 1, 13, 14, or 16.

As is apparent from the inspection of Figs. 1, 13, 14, 15, 16, 17, and 30, a marked peculiarity of my construction of the bicycle-frame is that I bend or place the saddle or saddle-supporting angle or point of the frame on or back of a vertical line which is parallel to and at equal distances from the lines passing vertically through the rear axle and crank-axle or from the line passing vertically through the rear axle and a line vertically tangential to the front outer edge of the tire of the rear wheel. Such construction brings the weight of the rider principally upon the rear wheel, and for this reason a greater speed can be obtained, while at the same time to the extent that the front wheel is relieved of the weight of the rider it can be more easily manipulated for steering purposes and with less lateral or twisting friction upon the ground as it is turned by the handles and steering-fork.

In Fig. 18 I show in front elevation the steering-head, in which it is seen that there are two parallel fork sides *k k* from the front axle to a point near the upper bearing of the frame. This form is preferable when the forks are made of wood, as the weight is borne on the upper ends and steadied at the lower bearing of the frame. A lighter fork can be used than when stopped just above the wheel, as in the present styles of bicycles.

The lateral connecting-pieces *l l* are fitted with a thread to receive the threaded pins *m*, on which the bearing-cones are arranged, as in Fig. 19. One cone in each bearing fits against the head of the pin, and the other fits into and moves with the angle-tips *h h* on the frame. The upper connecting-piece *l* not only extends across from one fork side to the other, but comes over and has a bearing on the ends of the forks, as shown in Fig. 18. The adjustment of the ball-bearings of the steering-head is made by screwing or unscrewing of one or both of the pins *m m* into or out of the lateral connecting-pieces *l l* and holding the same by the check-nut shown in Fig. 19.

The steering-head bearings may be arranged to throw the weight onto the lower set of cones; but I prefer to place the weight upon the upper ends and steady the lower bearing at the connecting-pieces.

The connecting-pieces *l l* are secured to the wood side by clips *n*, and to prevent a vertical or twisting movement I provide the dowel-pins *o*, which engage the holes in the wood in the manner shown in Fig. 19. The metal tips on the lower ends of the forks are fastened to the wood in the same manner and extend beyond the wood to receive the front-wheel axle. The connecting-piece may be shouldered into the wood; but the pins furnish the strongest and neatest way of accomplishing my object. It is not, however, necessary to use such a steering-head as has been described, as my improved frame can be adapted to the tubular head and the forks now in common use, as appears in Fig. 20.

Figs. 21 and 22 show a novel means of holding the rear-wheel axle to the frame. In previous constructions the rear axle is held between parallel forks open at the extreme rear or having the lower fork detachable, and it has been necessary to disconnect the chain or detach the lower fork before the rear wheel could be removed from the frame. My invention provides for the removal of the wheel without disconnecting the chain or disturbing the fork. I employ a single lug or extension *p* on each side of the frame projecting rearward. It rests upon the axle and is provided with a groove *r*, which is parallel to the bearing edge. A locking-piece *s* is made to receive and support the axle and by means of a laterally-projecting piece or teat *s'* engages with the groove *r* of the lug *p*, and when the axle-nut is screwed up the wheel is held securely to the frame. To prevent a bind on the thread of the axle, I provide a projecting piece or teat s^2, preferably integral with the locking-piece and having a length equal to the thickness of the lug or extension *p*. The projecting piece *s'* may engage the upper edge of the lug *p* instead of the groove *r* and be operative.

In Fig. 30, H is the fork-crown, having sockets or recessed lugs at its ends, into which the upper ends of the fork are received.

In Fig. 26, I is the seat for the saddle-post, which enters and passes the circular opening there shown. Said post can be secured in place therein by means of a clamping-screw. The seat I has a flange, at the ends of which are lugs recessed to receive the forked ends of the bar K.

J is a channel-piece preferably having the channel open on one side in which the forked ends of the bar K fit. Fig. 27 shows said channel-piece in detail, one view thereof being in elevation and the other in section on

the dotted line *y y*. A screw having a head passes through said channel-piece, as seen in Figs. 26 and 27, and enters the flange of the seat I. It is operated by the nut shown in said figures. If the screw is made with one portion threaded right-handed and the other left-handed, the head of said screw may be dispensed with.

The action of the screw is to draw the bar K toward the seat I, and so to tighten and stiffen the frame. The flaring or divergence of the channels or grooves in the part J and the forking or spreading of the ends of the bar K enable the channel-piece so to draw the bar K when the screw is turned. In like manner channel-pieces are placed at the ends or bends of the other bars in the bicycle-frame illustrated in Figs. 24, 25, and 30.

I claim as a novel and useful invention and desire to secure by Letters Patent—

1. In a frame for a bicycle or other vehicle, the combination of wood struts having forked ends socket-pieces adapted to receive said ends and adjustable tensional devices, engageable with said socket-pieces, substantially as described.

2. In a bicycle or other vehicle, a main frame consisting of struts having forked ends and laterally-extending cross-heads adapted to receive said ends, respectively, and tensional devices or stays connecting the ends of said cross-heads to form trusses for the purpose of stiffening said frame, substantially as specified.

3. In a bicycle or other vehicle, a main frame consisting of two or more struts, having forked ends and laterally-extending cross-heads adapted to receive the ends of said struts, respectively, and tensional devices connecting the ends of said cross-heads to stiffen said frame longitudinally and laterally, substantially as described.

4. In a bicycle or other vehicle, a main frame consisting of wood struts, metal socket-pieces adapted to receive the ends of said struts, respectively, and each having laterally-extending cross-heads and truss-wires connecting said cross-heads at the ends thereof, and also at points intermediate of said ends, substantially as shown.

5. In a frame for a bicycle or other vehicle, wood struts having forked ends in combination with tensional devices and means for connecting said struts and tensional devices to form a truss, substantially as described.

6. In a bicycle or other vehicle a main frame consisting of longitudinal struts extending approximately from end to end of the frame, converging at their forward ends and spread apart at their rear ends to admit a wheel between them, additional struts crossing the longitudinal struts and tensional devices connecting the said struts to form a truss, substantially as described.

7. In a bicycle or other vehicle a main frame consisting of longitudinal struts extending approximately from end to end of the frame, converging at their forward ends and spread apart at their rear ends to admit a wheel between them, additional struts extending approximately at right angles to the longitudinal struts, in combination with tensional devices connecting the said struts to form a truss, substantially as described.

8. In a bicycle or other vehicle a main frame consisting of longitudinal struts extending approximately from end to end of the frame, cross-struts approximately at right angles to the longitudinal struts, truss-wires for connecting the said struts to truss the frame, and provided with suitable devices for attachment to a steering-fork, and means for attaching a saddle, a rear-wheel axle and a crank-shaft to the frame, substantially as described.

9. In a bicycle or other vehicle, a main frame comprising wood struts arranged longitudinally to the frame, having their ends separated in both a vertical and a lateral direction, suitable connections between them, cross-struts above and below them, and tensional devices or stays applied to the whole to form a truss, substantially as described.

10. In a bicycle or other vehicle, a frame consisting of bars having forked ends spread apart and connecting-pieces engageable with said bars and provided with sockets to receive said forked ends and tensional devices to hold said connecting-pieces and bars together in said sockets, substantially as set forth.

11. In a bicycle or other vehicle, a frame consisting of bars having forked ends spread apart and connecting-pieces having sockets adapted to receive the tips of said forked ends, channeled pieces having grooves whose sides converge inwardly and adapted to receive said forked portions of the bar to engage the flaring edges thereof and a screw passing from said channeled pieces to said connecting-pieces, substantially as described.

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