A VISE FOR JEWELERS, TOOL MAKERS, ETC.

The illustration represents a vise in which the jaws have a positive opening and closing movement in parallel lines, both jaws being simultaneously actuated by a right and left hand screw. This vise was patented by Charles E. Billings, and is manufactured by the Billings & Spencer Company, of Hartford, Conn. The illustration represents the vise held in a special form of clamp fitting it for use as a bench vise. All parts

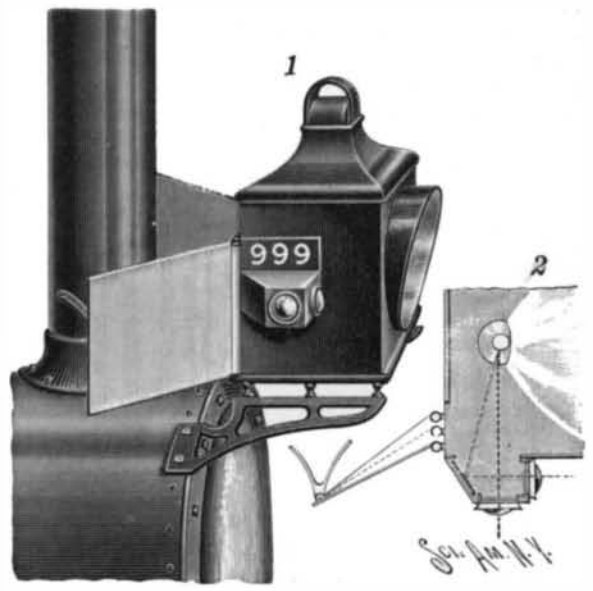
THE BILLINGS VISE.

are drop forged of the best steel. There is a hole entirely through the vise handle, the lower part of this hole being threaded, and the vise is adjustably held in the bench clamp, at any desired angle, by means of a screw and thumb nut, a pin preventing this screw from dropping out of the clamp. The vise may thus be readily taken out and used as a hand vise, or placed in position as a bench vise. The jaws open three-quarters of an inch, and will grasp and hold central round wire from one-sixteenth up to one-quarter inch in diameter.

ELVIND ASTRUP, Peary's companion, who perished in a Norwegian snow storm last Christmas, has now a memorial stone 26 feet high erected in his memory in the forest of Holmonkollen, at Christiania.

A LOCOMOTIVE HEADLIGHT AND SIGNAL.

According to the improvement represented in the illustration, the light emanating from the lamp in the headlight not only illuminates the track in front of the locomotive, but is also utilized to illuminate signal lenses looking toward the front and to each side. The improvement has been patented by Thomas Frame, of Salida, Col. Fig. 1 shows the headlight and signal in position and Fig. 2 is a sectional plan view. In each side of the headlight casing is a compartment which has at its forward end and on the side a lens, a reflector at the rear of the compartment throwing the light rays through the forward lens, while the rays from the lamp pass transversely through the side lens, as shown in the plan view. Each lens may be screened by panes of colored glass, to signal with any desired colored light. Sheet metal flags for day signaling are also adapted to be displayed on the sides of the locomotive, between the back of the headlight casing and the smokestack, the flags being preferably made of thin metal sheets, differently colored, and each wound on a spring roller, the several rollers being journaled side by side at the back of the casing, and the free end of each sheet being drawn rearwardly and hooked on to a bracket on the smokestack. While any special flag is thus moved into position for signaling, the other flags remain wound up on their rollers.



FRAME'S HEADLIGHT AND SIGNAL.

THE BICYCLE WHEEL.

BY E. D. SEWALL.

The modern bicycle is an excellent example of a meritorious invention consisting, in the language of the patent law, of a new combination of old and well known devices. There is no essential part of the bicycle that is not, in principle, more than thrice the age of the modern safety, while some of the features are inventions of previous centuries.

The wheel of the bicycle attracts the eye of the thoughtful observer probably more than any part of the machine. It illustrates perfection in principle and the utmost delicacy of the visible parts.

It is built upon the suspension principle, the load carried upon the axle being suspended from the rim, instead of being supported on the spokes that fall beneath the axle, as in the more ancient and more common form of "compression" wheel. In the suspension wheel the great tensile strength of steel wire sustains a heavy strain and yet enables the wheel to present an appearance of great delicacy. "Spider wheel" it was called in England, when it first appeared on the velocipede, and the name has not yet gone wholly out of use.

Contrary to the general opinion, the suspension wheel is one of the oldest of all the old and well known parts that enter into the combination that makes up the modern bicycle. Both England and France have claimed the honor of its invention. The cycling writers of England brought forward Edward Cowper as the first inventor, placed the date of invention in 1868, and pointed to the "Phantom" bicycle of 1869 to show it in practical use. The French replied that René Olivier, a distinguished mechanical engineer, who had experimented considerably with the velocipede, had proposed "les roues de fil de fer" in 1864, and had applied them to a two-wheeled velocipede in 1867. A search of the records of the British patent office enabled the English to establish a still earlier date, 1826, while the French did not attempt to claim back of the date of Olivier's alleged invention.

It is a fact, however, that the invention of the suspension wheel precedes the discovery of America by Columbus. The autograph manuscript left by Columbus' great countryman, Leonardo da Vinci, that universal genius, contains a sketch of a suspension wheel, and an autograph note describing the invention as one "by which wheels are strengthened and a light wheel made strong." A model of Da Vinci's wheel has been made from his sketch and placed in the National Museum at Washington. The invention antedates 1490. It is shown in one of the accompanying figures.

The next record of the suspension wheel is found in the British patent office. In 1826 a London accountant named Theodore Jones filed his application for a patent for "an improved construction of carriage wheels, of such nature that the weight they have to carry is suspended from that part of the wheel which happens to be uppermost, instead of being supported, as is usual, by the spokes that happen to be under the axle tree." The spokes of this wheel were light iron rods and the rim was a hoop of iron. The inner ends of the spokes passed through a flanged hub and were held from withdrawal by nuts screwed on their

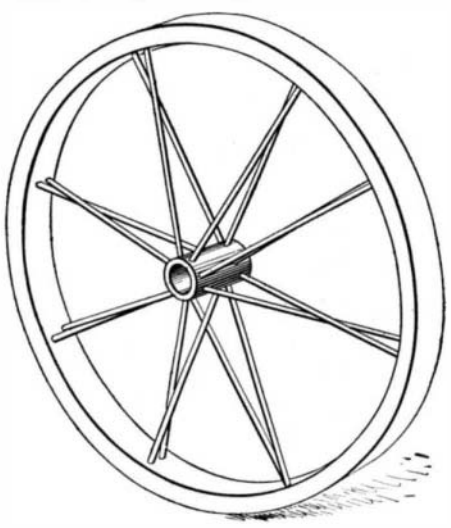


Fig. 1.—DA VINCI'S SUSPENSION WHEEL, 1490.

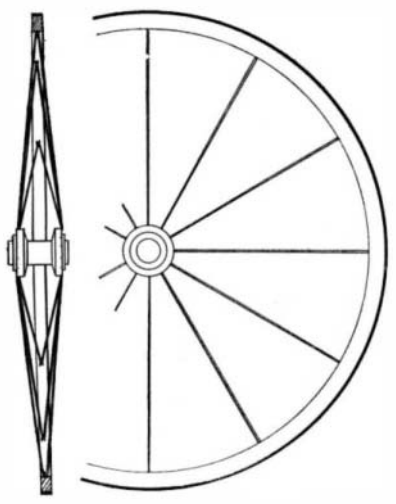


Fig. 2.—"PHANTOM" WHEEL, 1869.

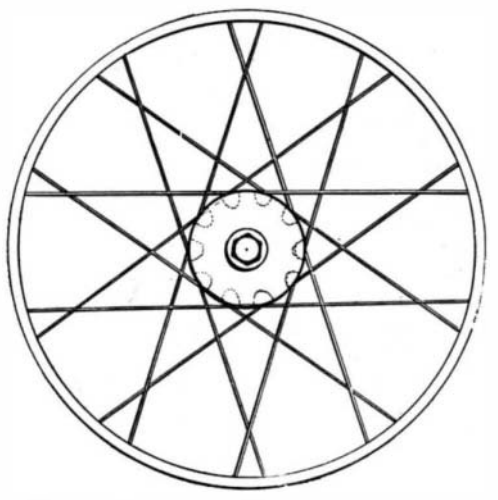


Fig. 3.—FIRST TANGENT WHEEL, 1869.

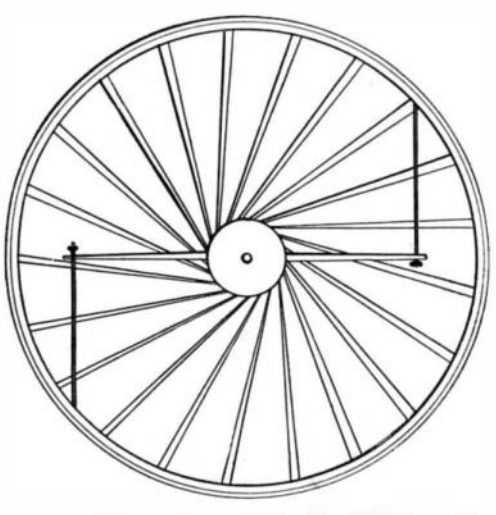


Fig. 4.—CROSS LEVER TENSION WHEEL, 1870.

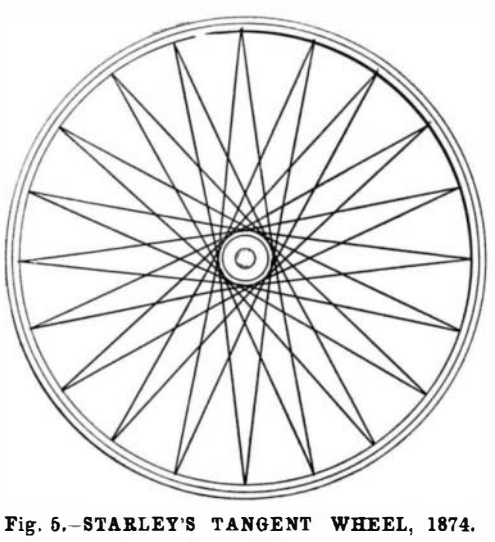


Fig. 5.—STARLEY'S TANGENT WHEEL, 1874.

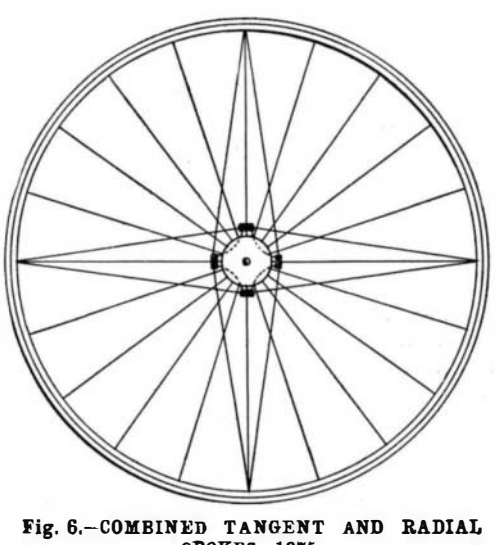


Fig. 6.—COMBINED TANGENT AND RADIAL SPOKES, 1875.

EVOLUTION OF THE BICYCLE WHEEL.

ends. The outer ends were headed or riveted into the rims. The patent shows the wheel with a single row of spokes radiating from a single flanged hub, and also a double row converging from a double flanged hub toward the rim.

In these early inventions are found the principles and the essential features of the modern bicycle wheel. Although used to some extent on other vehicles, it was the coming of the bicycle that developed the possibilities of the suspension type of wheel. Each owes its fame in great measure to the other, and since its adoption as a part of the bicycle, "the spider wheel" has advanced in perfection with the advances in the mechanical arts and processes of manufacture, and in minor details that adapt it to its special use.

The earliest absolutely authentic application of the suspension principle to the bicycle wheel occurred in 1869. In that year William F. Reynolds and Jonathan A. Mays, of London, England, applied for a patent for a velocipede which was afterward known as the "phantom double steerer," and was widely used. Its wheels were provided with bent wooden rims and metal tires. Eye bolts were passed through the rim and tire from the inside and riveted into the tire. Suspension wires were threaded through the eyes in the rim and their opposite ends carried to opposite flanges on the hub. The ends were bent at right angles and hooked into holes in the flanges and then clamped in place. The hub was screw threaded and provided with collars correspondingly threaded, so that by turning the collars the spoke flanges could be moved apart and the spokes thereby drawn taut. In this day of the wooden rim it is interesting to note that this first bicycle wheel of the present type had rims of wood. Fig. 2 shows two views of this wheel.

The first radical improvement was the invention of tangent spokes. When the driving power is applied to the hub of a wheel and the resistance is at the rim, as in the bicycle, the tendency of the rim is to drag behind and of the spokes to wind on the hub or bend to a direction tangential to the hub. The tangent wheel was invented and the spokes were placed in the position which they tend to assume by reason of the driving strain, and hence exert a pull upon the rim along their length, thus avoiding in part the sharp bending strain on the spoke at its point of attachment to the hub. An American, Obed Look, on August 31, 1869, patented a wagon wheel which appears to be the earliest example of the tangent spoked wheel.

On August 11, 1870, James Starley and William Hillman, of Coventry, England, patented a bicycle wheel with approximately tangent spokes. They constructed a wheel with grooved rim and rubber tire, and spokes of steel ribbons secured at one end to the flanges on the hub and at the other end to the rim. Rigidly secured on the hub were two bars projecting radially in opposite directions. A rod fastened in the rim at one end extended through the outer end of each of the tension bars, practically at right angles, and a thumb nut was screwed on to the threaded end of each rod. By turning up the thumb nuts the rim would be turned relatively to the hub and the spokes drawn to tension tangential to the hub. This wheel was used for two or three years on the early Ariel bicycle, and was known as the cross lever tension wheel.

The tangent wheel, very much as it is used to-day, was patented in England to James Starley in 1874. This patent showed the hub suspended within the rim by spokes of steel wire extending in pairs from points on the rim to opposite sides of the hub flanges. In the modern tangent wheel the spokes, instead of diverging in pairs from points on the rim, are equally spaced on the rim and extend alternately to opposite flanges on the hub. Otherwise the bicycle wheel of the present is substantially similar to Starley's wheel of 1874.

The bicycle wheel has to withstand the lateral strain that tends to "dish" it, the downward strain on the axle, and the torsional strain of the driving devices on the hub. The first of these is well withstood by the truss-like action of the spokes diverging from rim to the opposite ends of the hub; the second is theoretically best resisted by a wheel with direct or radial spokes; while the third is provided against best by tangent spokes. The cross lever tension wheel was weak to withstand the dead weight of the load, although strong to resist the driving strain. Attempts to combine the good qualities of both tangent and radial spokes have been made from time to time, and a number of patents have been obtained for various combinations of the two. English patent to Carter, dated August 17, 1875, is a representative example of such a combination wheel. At the present time it is the general conclusion that a properly constructed tangent wheel is the best for bicycle construction, and yet it was not adopted to any wide extent until Americans became extensive manufacturers of bicycles. They were quick to recognize the general superiority of the tangent wheel, and to-day the use of the tangent wheel in bicycles is universal.

In the early period of the suspension wheel there was no uniformity in the methods of fastening the spokes in rim and hub. Gradually it came to be the practice to screw the spoke into holes in the hub flanges and rivet them into the rim. This caused a distinct weakness in the wheel, because the threads were liable to be stripped off. In such wheels broken spokes were frequent after a few months of wear. American makers generally adopted the method of securing spokes in the hub by heading the end of the spoke, threading it through some part of the hub and screwing the other end into a nipple inserted in the rim. English makers have now adopted the same method, and a broken spoke is a comparatively rare accident to the cyclist.

The ordinary method of securing the tangent spoke to the hub is to provide flanges on the hub, drill holes through the flanges parallel with the axis of the wheel, and thread the headed spoke through these holes and then bend it sharply at right angles so as to form a hook in the hub flange. To avoid the necessity of bending the spoke, various devices have been resorted to, such as turning the flange of the hub and crimping it, or providing projections through which it may be threaded and extended to the rim at right angles to the projection. Where there is no flange, as in some of the modern tubular hubs, the spokes are locked in place in various ways in holes drilled in the hub tube.

The first rims used with rubber tires were of solid metal grooved to receive the tire. In 1877, J. S. Smith, of London, England, produced the hollow metal rim. This was a great improvement, and in the first half of the last decade was considered one of the triumphs of cycle construction. These rims were made of lapped and brazed sheet metal in one, two, or more pieces, generally thickened or reinforced where the spokes entered the rim. In later years they were made of drawn tubing rolled into the proper shape. With the advent of the safety the hollow rim disappeared for a time, to be revived, lately, in England, where the American wooden rim has had serious opposition.

The most radical change in bicycle construction since the introduction of the pneumatic tire has been the substitution of wood for metal rims. This is a purely American innovation. About 1892 wood rims were proposed; the following year saw them in use, and in 1894 the use had become general and is now universal in the United States. The English still offer strenuous opposition to the use of them in their country, on the ground that wood rims are not adapted to their climate. From present indications the wooden rim seems likely to conquer. As stated before, there is nothing novel in the use of a wood rim on a suspension wheel. The patents on wood rims are for certain specific details of construction, such as for the character of the joint, and specific construction of rims made of strips cemented together.

The Production of Cloisonne Ware in Japan.

The production of cloisonné goods was, says the Swiss consul at Yokohama, introduced into Japan from China in the sixteenth century, and was started at Nagoya, which is still the headquarters of the industry, although it is successfully carried on at other places. Owing to the great spread of Japanese curios, favored by the fashion of the day, almost every one is acquainted with the Chinese or Japanese cloisonnés, those vases, plates, or other metal objects coated with a shining enamel of many colors, and ornamented with strange drawings and designs brought specially into relief by the colored enamels. An authority on Japanese art gives the following interesting account of their manufacture. The copper vessels are provided internally and externally with projecting rims of brass, the height of which determines the thickness of the layer of enamel with which the objects are to be coated. The outlines of the design are marked on the copper with white lead. Following the lines of this design, narrow strips of brass are bent by means of wire pliers into all sorts of small shapes over a glass plate. The strips so bent are fastened by their edges to their places on the design, at first temporarily, by means of a special cement, and later on, more durably by an easily melted solder. After this process, the surface of the vessel appears entirely covered with a network of cells. These cells are then filled out with powdered vitreous matter reduced to a paste by the addition of water; when these colored enamels are dry, the vessel is placed on the furnace for the first time. During the burning process the colors harden and sink beneath the level of the edges of the cells. All these depressions are filled up after the vessel has cooled, and it is then heated again, the process being repeated until all the cells are equally full. Finally, the surface is smoothed and polished, and receives a questionable improvement by means of vegetable wax and a coat of paint. The enamels are burnt in small vessels which are not placed in special furnaces, but have charcoal packed round them, which is fastened by wire and set alight. This apparently primitive process allows the intense heat to be suddenly withdrawn by snatching away the charcoal; this prevents the enamel, which readily liquefies, from running out of the cells, and consequently seems necessary to the success of the operation. A similar process has also been adopted within the last few decades, principally at Nagoya, for ornamenting porcelain and earthenware vessels with enamel in cells. For this purpose the surface which is to receive the enamel is left unglazed, and the solder falls away while the enamel adheres tightly to the rough earthenware surface as a kind of glazing. At the Tokio Exhibition the cloisonné makers of Nagoya were represented by numerous exhibits, some of which were very fine, but it is stated that really good specimens of this ware are very dear. Very small vessels, with the cell walls made of silver, were marked at 150 yen, rather larger ones, with splendid coloring, at 175 yen. Instead of using copper vessels, manufacturers have already begun to produce vases of solid silver; this, of course, considerably increases their cost.

The Development of Africa.

Henry M. Stanley, M.P., has written an article entitled "The Story of the Development of Africa," which appeared in the February Century. Recent events in Africa give this a particular timeliness and importance. Concerning the partitioning of the continent Mr. Stanley says: "Within the last ten years France has acquired of equatorial Africa about 300,000 square miles, in which there are now 300 Europeans; Germany, 400,000 square miles; Italy, 547,000 square miles; and Portugal has now a defined territory extending over 710,000 square miles. France, moreover, has been active farther north, in the Sahara and in west Africa, and claims rights over 1,600,000 square miles, while Germany, in southwest Africa and the Cameroons, asserts her rule over 540,000 square miles." England was the last European power to engage in the rush for African territory. Her efforts for some years after the Berlin conference had been confined to reserving spheres of influence, rather than to violent annexation, and to moderating the passion for African land manifested by Germany, France and Italy. If any power had the moral right to interfere with this fierce lust for annexation, it must be admitted that, after policing the African coasts for over half a century, exploring the interior and establishing Christian missions in East Africa, Nyassa Land and Uganda, England was fairly entitled to it. Between 1886 and 1890 Englishmen began to stir and succeeded in forming the famous South African Company, the African Lakes Company and the I. B. E. A. Company. The Royal Niger Company had obtained a charter in 1886, and in October, 1889, a somewhat similar one was granted to the South African, with administrative power over 750,000 square miles. In 1891 it absorbed the African Lakes Company, and thus British Central Africa, with 500,000 square miles, was formed. To the British East African Company was given authority over 700,000 square miles. By placing these statistics in a tabular form the reader may best see the subdivision which has taken place since February 25, 1885:

	Sq. Miles.
To the Congo State, by consent of the powers	900,000
France annexed	1,900,000
Germany	940,000
Italy	547,000
Portugal	710,000
Great Britain—	
South African Company	750,000
British Central Africa	500,000
British East Africa	700,000
Total	6,947,000

The Bloated Railway Shareholders.

Poor's last Manual shows that the entire interest paid in the United States on railway bonds and other debt, together with the dividends on stock, averaged only 2·94 per cent for 1895, while dividends on stock alone averaged only a pitiful 1·59 per cent. What farmer or other property owner would be satisfied with a return of a little over 1½ per cent a year? If it be answered that some stocks have been "watered," a liberal deduction on that score would still leave the average returns on stock bought by bona fide investors far below those to which ordinary investments are entitled. But bonds are not watered, yet the interest which they have yielded for many years has been very much less than the ordinary interest rates on the average. Poor's Manual figures that and the dividends on stock since 1890 as follows:

	1890.	1891.	1892.	1893.	1894.	1895.
Interest per cent of bonds	4·27	4·25	4·25	4·30	4·11	4·25
Dividends per cent of stock	1·80	1·85	1·93	1·86	1·64	1·50
Interest and dividend per cent stock and debt	3·04	3·06	3·01	3·02	2·89	2·94

When it is remembered also that hundreds of millions of capital stock and bonds have been wiped out of existence, and, moreover, that in scores of cases of reorganization holders of securities have been heavily assessed in order to retain some evidences of their investment and a chance of a little return in the future, it will be admitted that the railway stockholder and bondholder is not to be envied on account of the undue profitableness of his speculations.—Railway Age.

The Canals of Mars.

A telegram has been received at Boston, October 5, from the Lowell Observatory at Flagstaff, Arizona, announcing that the canals of Mars, known as Phison and Euphrates, have been observed again to be double.