SUGGESTIONS and information are invited from manufacturers, repairers and users of Bicycles in regard to desirable methods of Bicycle repairing, of which appropriate use will be made in the current series of articles in THE IRON AGE and in future editions of this book.

BICYCLE REPAIRING.

A Manual Compiled from Articles in
THE IRON AGE.

BY S. D. V. BURR.

THIRD THOUSAND.

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THIS volume is based upon a series of articles in *The Iron Age*, which were published in view of the obvious need of practical information in regard to approved methods of Bicycle repairing. In its preparation the aim has been to confine the description of methods to those which have been tested and found practical in actual use The volume is therefore the result of experience rather than theory.

Acknowledgment is made of the hearty and intelligent cooperation of the manufacturers and repairers of Bicycles in giving suggestions and furnishing information, thus greatly aiding in the compilation of the matter contained in the following pages. It is hoped that the volume will be of service not only in the large establishments, but more especially in the smaller repair shops springing up all over the country.

The field of Bicycle repairing is a large one, and the series of articles which have appeared in *The Iron Age* will be continued with a view to describing new and improved methods as they are developed in the progress of the trade, as well as to give information on any details which may not be adequately treated in this volume. Further suggestions and information are therefore invited from any who are interested in the subject, of which appropriate use will be made in *The Iron Age* and in future editions of this book.

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Introduction.

The Bicycle of to-day is built on scientific principles by the most competent mechanics and of the strongest and best materials. Although no expense is spared by the leading manufacturers in their efforts to produce perfect wheels, it happens unfortunately that, through accident or abuse, the machine is injured and breaks down. It therefore requires at times the attention of one having knowledge of the methods necessary to repair it. Placed in the hands of an inexperienced practitioner it may be permanently injured and perhaps ruined, but if treated by one skilled in the art it may be restored to its original strength and usefulness.

The wonder is not that the Bicycle occasionally breaks down but that it lasts as well as it does. When we consider the relative weight of the wheel and its rider, and think of its apparently frail construction, and then remember the severe strains to which it is subjected in service, we are compelled to admire its design, the strength of its parts, and the perfection of its workmanship. When a machine of this character, so delicate in its component parts and so finely adjusted, is in need of repair, it should evidently be taken to one who will understand the difficulty and who knows how to apply the proper remedy.

This seeming delicacy of the Bicycle has been of the utmost importance to the Bicycle trade as a whole. To it, and to it alone, can be ascribed the wonderful scarcity of really poor wheels. The Bicycle is a chain, and every part constitutes a link which must of necessity bear its portion of the strain. To weaken one of these links or parts by the introduction of inferior material means the speedy destruction of the wheel. To keep up the strength by using a greater quantity of cheap metal would meet with no demand, because the rider of to-day will not mount a heavy wheel. This delicacy is, in a certain sense, a guarantee of the honesty of manufacture of the wheel, and the Bicycle itself is the best safeguard against imposture.

The millions of Bicycles now in use have created a demand for the services of bright mechanics. Almost every town, no matter how small in population, can boast of some one who at least professes to make a specialty of Bicycle repairing. Unfortunately, too many men have gone into this business who have had no previous training to fit them for the work. They thought the Bicycle was as easy to repair as it was simple in appearance. These men have succeeded—in ruining thousands of good wheels. On the other hand, there are men in this business who are mechanics of experience, who have studied the wheel as they would an intricate problem, and who can repair it so as to bring it to its first condition of usefulness. When a manufacturer knows his wheel will be repaired properly he prefers that the work should be done at the shop nearest the home of the owner rather than that it be sent to his own works. The principal reason for this is that the rider is not deprived of the use of his wheel for so long a time.

In the matter here following we have attempted to tell how to repair a Bicycle. We advance no theories, but describe, as plainly as possible, how each individual part of a wheel can be repaired. We also show, as far as was thought desirable, different methods of doing the same job. In almost every instance the illustrations represent the work as actually performed, and there has been no attempt to introduce fictitious methods.

CHAPTER I.

The Equipment of the Shop.

In this chapter it is proposed to enumerate the appliances which can be bought for certain sums of money, and which, for the amount specified, would seem to best fit the conditions of a general repair shop. We are well aware of the fact that there is much diversity of opinion regarding the tools which should, of necessity, form part of the equipment, and also that the choice is often influenced by the particular line of work the repairer intends to take up, and by his location and surroundings.

The extent or thoroughness of the repair outfit is controlled by two things: 1, The amount of money the repairer has to invest in tools, and 2, the scope or range of the business he expects to carry on. If his capital is limited he cannot, of course, provide all the appliances ordinarily considered essential. If he is unhampered as far as expenditure is concerned he can furnish everything needed, even to those devices which are luxuries rather than necessities. All things considered it is best to start in a modest way and to increase the stock of tools to meet the demand. This will guard against the buying of devices which may be expensive, and which are called into service only occasionally. It is not good policy to lock up the money in this way when it can be employed to far better advantage. On the other hand, if the outlay is unrestricted, the shop may be cumbered with fine apparatus which the business carried on does not demand, and the profits, when the balance sheet is made up, will be reduced because of unproductive machinery.

One course the repairer should decide at the start. There are certain tools he must buy, but with those he can make others of minor importance. How far this may be carried will depend solely upon his ability; if he is a trained mechanic many of the devices described in the following pages can be constructed during his leisure moments.

In the following list of tools we have assumed the money available to be $100, $300 and $500, and have therefore divided the subject into three parts.

Equipment for $100.

It is evident that with this amount only the small tools can be purchased, and the shop must be run solely by hand and foot power. And yet there are many repair shops which are now doing business successfully, and which are not provided with tools worth $100. With only this amount at command, several important tools of undoubted value must be omitted. These are, in the order of their importance, the screw cutting lathe, upright drill, brazing table, air reservoir and its pump, enameling oven, and steam or gas engine, or electric motor or water motor, for driving the tools. While this amount will not include the screw cutting lathe it will permit of the introduction of an ordinary speed lathe, and with this much of the work can be done, although at a disadvantage. The upright drill may be replaced by the so-called blacksmiths' drill, which may be had for $10 or $15. The repairer can easily provide the table with suitable chucking devices for holding work of different kinds.

Unfortunately, since the Bicycle manufacturers have no standard of sizes, and no common or uniform method of doing work, it is necessary for the repairer to provide more tools than would be otherwise needed. This is particularly noticeable in the taps and dies required. The same size of spoke may call for three or four different threads, according to the whim of the maker. While this condition of things is being gradually brought to some degree of uniformity, the repairer is not aided at the present time.

LIST OF TOOLS FOR $100.

Taps and Dies with Stock and Tap Wrench in sizes as follows: 1/16, 5/64, 3/32, 7/64, 1/8, 9/64, 5/32, 3/16, 7/32, 1/4 inch	$9.00
Drills for above	2.00
Drills from 1/4 to 7/8 inch by 16ths	3.85
1 set Taper Reamers, 1/4, 3/8, 9/16, 3/4 inch	1.70
1 Hand Drill	1.50
1 Drill Gauge	1.50
1 Thread Gauge	1.00
1 Ball Pein Hammer	.90
1 Riveting Hammer	.50

1 Hide Faced Hammer	1.25
1 Lead Hammer	.40
1 Lignumvitæ Mallet	.50
1 Bench Vise	7.00
1 Pin Vise	1.25
1 14-inch Pipe Wrench	3.00
2 6-inch Monkey Wrenches	1.00
1 15-inch Monkey Wrench	1.20
1 pair Round Pliers	.45
1 pair 10-inch Gas Pliers	.60
1 pair Cutting Nippers	.90
1 pair side Cutting Pliers	1.00
1 Oil Can	.35
1 50-pound Anvil	5.00
1 Brazing Blow Pipe	3.00
1 Foot Bellows	5.00
1 Belt Punch for punching holes in tires for lacing	.60
1 Bit Brace	2.00
1 pair Outside Calipers	.40
1 pair Inside Calipers	.40
1 pair Dividers	.50
1 Screw Clamp, opens 6 inches	.45
1 2-foot Rule	.15
1 Hack Saw Frame	.90
1 dozen Hack Saws	.65
2 Screw Drivers	.50
1 Foot Pump and Connections	2.00
Brazing Solder	1.00
1 Portable Forge	12.00
1 Center Punch	.20
1 Grindstone	4.50
1 Oil Stone	.50
1 ½ and 1-inch Chisels	.70
1 Blacksmith's Drill	12.00
1 Cold and 1 Cape Chisel, 1½-inch	.60
1 Hand Drill	1.50
1 Breast Drill	3.00
2 12 inch Bastard Flat Files 2 9-inch Bastard Half Round 1 9-inch Smooth Half Round 1 9-inch Smooth Round	1.50
Total	$99.90

Some of the items in the above may be considered as superfluous by the repairer. We think the two most doubtful items are the forge and grindstone, which cost together $16.50. While these would be of the utmost use if the outfit included a lathe, which would require the making of cutting tools, they can in this case be dispensed with. All brazing, soldering, etc., can be done with the brazing blow pipe. The sum represented by the forge and grindstone could be expended as follows:

A second Brazing Blow Pipe to be arranged so that the flames of the two would meet as in the Brazing Furnaces hereafter described	$3.00
Gas Pipe connections and table for same, with the necessary Fire Brick, etc., the work to be done by the repairer	7.00

This arrangement would be more convenient than the forge and would meet every requirement admirably. The balance of the amount, $6.50, can be profitably expended in increasing the line of taps, dies and drills, and in stocking up with brazing solder, rubber cement, patches for rubber tires, etc. It is presumed that the repairer will make all the work benches, racks, shelves, and similar articles.

Equipment for $300.

The amount now to be expended for tools being $300, the repairer can add the most essential machine tools to the list of small tools enumerated above. The first and most important is the lathe. This, of necessity, must be arranged for foot power, as the sum of money in hand will not provide power for the shop. A 12-inch swing over the ways will meet all ordinary requirements. The lathe should be screw cutting, and should be provided with face plate, drill chuck, inside and outside chuck, and the cutting tools. A lathe of this kind of good make can be bought for $125, and the attachments needed for $20.

Next an emery wheel grinder for $15. An upright drill may be had for $40, and will be found exceedingly useful for such work as drilling the holes in chain links, flanges of hubs and the like. The account now stands as follows:

Amount expended for small Tools	$100.00
Lathe	125.00
Lathe Attachments	20.00
Emery Wheel Grinder	15.00
Upright Drill and Attachments	40.00
Total	$300.00

If deemed advisable by the work it is expected to do, the emery wheel grinder can be dispensed with and an enameling oven built for the amount it would cost, provided the repairer did the work himself.

Equipment for $500.

With this amount it is possible to run the shop with power. In the vast majority of cases a steam engine would be out of the question, as power is only occasionally required. A gas engine or electric motor is preferable, as either may be started instantly, and there is no expense incurred except when some work is being performed. Putting the cost of either of these at \$125, we have \$75 left. Of this, \$35 should supply the shafting, pulleys and belts. For the balance an air tank, to hold air under pressure for blowing up tires and running the forge, and the air pump may be purchased. The account now stands:

Small Tools and Machines	\$300.00
Gas Engine or Electric Motor	130.00
Shafting, etc	35.00
Air Tank and Pump	35.00
Total	\$500.00

The above lists are only offered as suggestions. The desires and demands of each individual must largely influence the selection. Some repairers would do away with all of the last items and might expend the \$200 in a larger and better enameling oven, a brazing furnace, a larger lathe and in adding to the stock of small tools, and in the purchase of some of the most useful special appliances which have been designed for repair work.

Work Bench.

The work bench illustrated in Fig. 1 will be found very convenient in a small shop. It should be erected where daylight is abundantly supplied by one or more windows, and must be screwed to the floor, and, better still, also to the wall along the window side. Select for the top of the bench three lengths of 2 x 10 inch hardwood lumber, dressed on upper sides and all around on the 2-inch sides. Make a true joint where the timbers butt, and at every 30 inches bore ½-inch holes through the timbers, as indicated by the dotted lines A A A. The joints are then to be glued and held together firmly by ½-inch bolts with large washers and nuts.

A very close fit of the top timbers is especially desirable, as small screws, oiler covers, flat springs, balls and similar parts of diminutive proportions, when placed upon a bench with fissures between the timbers, are liable to drop through the openings and disappear, sometimes never to be located again. A well-made top will also keep dust, filings and dirt out of the tool drawer, which may be located about as shown in cut. The legs L and cross timbers C should be pine posts 4 x 4 inches, and let into each other under the top of the bench. Along the front edge of the bench there is fastened by means of screws a ¾ x 2½ inch strip of hard wood, to project above the top of the bench ½ inch. A similar strip is secured to the opposite edge, but measuring ¾ x 3 inches, and projecting 1 inch. These strips will prevent small tools and parts rolling off the bench. In the sketch, over the leg on the right hand side, the location of the vise is indicated. The overhanging portion of the bench to the right of the vise will be found very useful for a

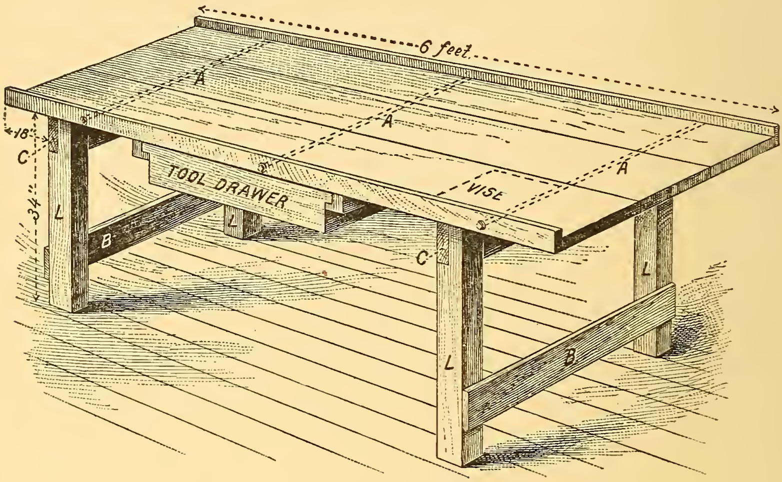


Fig. 1.—Work Bench.

supply of tools when working at the vise. All braces, B, can be made from 2 x 4 inch pine. Nail a 1 x 3 inch board on the inside of the left leg, leaving a space of 1¾ inches between the leg and board. This is very useful and serves as a stand for an assembled Bicycle while repairs are being attended to, which makes this position of the machine desirable. Boards laid over the two braces B and B make a very good place for keeping certain parts of Bicycles, as wheels and so on, while others are being repaired. The described bench is about as large as it should be for one repairer or assembler to conveniently work at, but these proportions can be repeated in any desirable and continuous length, if more than one vise is to be set up. All of the principal dimensious are marked on the drawing.

Parts Carried in Stock.

The repairer may consider the parts to be carried in stock as part of the equipment.

All parts of Bicycles are made upon the interchangeable system—that is, a certain part of one wheel will fit, and fit perfectly, in the place of the same part in any other wheel of the same design built by the same company. In addition, every maker keeps in stock duplicate parts of each different machine he turns out, most of them keeping duplicates of every part of every design they have ever produced. As any of these can be obtained by expre-s upon a telegraph order, each individual repairer must decide for himself which parts and how many he will carry in stock. Some parts, such as crank shaft brackets, are expensive and are not often required. Others, such as spokes and tubes, are more frequently in demand.

It is a safe rule, and one followed by many repairers, to have on hand all of the parts of all of the machines for which they are agents. This insures the prompt repairing of their own wheels and pays as a business investment. Beyond this there is no rule ; the judgment of the repairer and the probable requirements of his customers are the only guides.

In nine cases out of ten it does not pay a repairer to make any part of a Bicycle if he can obtain it from the maker in time to suit his customer. The manufacturer is interested in the repair of his wheels, and he is usually prepared to furnish parts cheaper than the repairer can make them. One important advantage arising from keeping parts in stock rather than making them is the fact that the accuracy of the repaired wheel is assured and its appearance is not marred by having clumsily made or poorly fitting pieces introduced.

Shop Arrangement.

In order to do work quickly and economically, it is of the utmost importance to have a well arranged shop, of such size and shape as to provide ample space for all the tools, and for the storage of wheels and parts, and, what is most essential, to be well lighted. While these are considerations of value, we are aware of the fact that in the vast majority of cases the tools must be made to fit in a room which is, perhaps, not adapted to the work and in which the best arrangement cannot be obtained. Very rarely does it happen that the room can be made on pur pose to accommodate the tools and to provide the best possible place for all the necessary devices. The skill of the repairer and his knowledge of the requirements of the work must therefore be called into play in order that he may utilize every foot of space in the room he is to occupy. If the quarters are not amply lighted throughout he must place, as far as possible, those tools intended for fine work—the lathe, for instance, and the benches for hand work—where they will receive the most light.

We can probably best illustrate this subject by describing the arrangement of one or two shops which differ from each other in shape and in the light openings and by showing the disposition of the tools made by the owners. The shops illustrated were selected as, being in a certain sense representative or typical arrangements, they well serve to point our remarks. The first, Fig. 2, is a one-story building, 96 feet long by 23 feet wide. Theie are no side lights, but there are two skylights, one in the showroom and the other in the repair department. The front is entirely of glass, the entrance being in the center, with show windows upon each side. To the left of the door is the private office, which is formed of glass partitions about 7 feet in hight. To the right is a railed in space occupied by new Bicycles. To the rear of this are a showcase and shelving containing Bicycle sundries. Along the entire opposite wall are placed 28 stalls, 18 inches apart, and numbered. These are rented to persons who wish to store their wheels during the daytime when they are at business. In the center of the room is a second row of 19 stalls, for holding wheels for renting and also those which are brought in for repair. These stalls are arranged diagonally, so that the wheels occupy but little space. At the corner of the office are valve couplings to fit any valve and a pipe leading to the air tank in the repair shop.

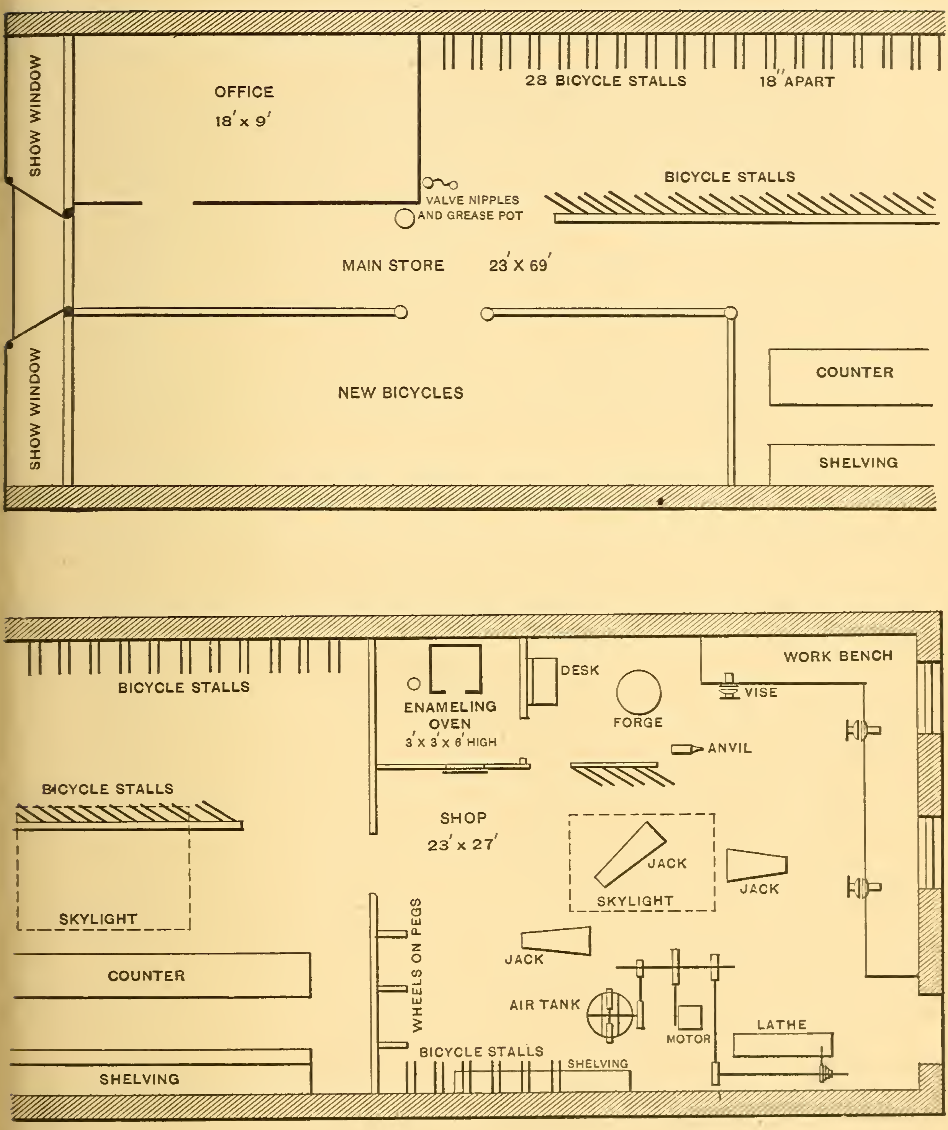


Fig. 2.—Repair Shop in Store.

Riders are welcome to use the air here provided and also the lubricant for chains.

Twenty-seven feet from the rear of the room is a partition which separates the repair room from the front. To the left is the enameling oven, which is completely inclosed in glass. To the right are the desk, forge for brazing, anvil and work bench, which extends around the corner and across the rear wall to the door. Shelves are placed on the wall above the bench and also underneath the entire bench. To the right of the entrance is an electric motor which drives the lathe, and the pump supplying the air tank. Electricity is obtained from the street car circuit. To the left of the motor are stalls, shelves and places for keeping parts of wheels. On the ceiling are pulleys, through which pass ropes by means of which wheels on storage and those which are not to be called for for some time may be hoisted out of the way.

A further illustration of how the tools may be placed in a Bicycle repair shop is shown in Fig. 3. This building was erected to serve as a repair shop. One of the main advantages it possesses over a store is in having an abundance of light, which is admitted through windows on all sides. Although, at first glance, the various tools appear to be too much crowded together, such is not really the case, as they are all located against the walls, leaving the center of the room comparatively clear. The main building is one story in hight and measures on the ground 15 x 54 feet. At the front is the private office and show window for the display of wheels and sundries. A space of 24 feet in the center of the building is occupied by platforms on each side, which are raised about 12 inches from the floor, and are intended for the exhibition of new wheels. Back of this is the repair shop proper, which is amply lighted by windows on three sides. Power is obtained from an electric motor placed in the upper right hand corner as we look at the drawing. Power is transmitted by belt from the motor to the main driving shaft hung from the ceiling and extending the length of the room. Belts lead from this shaft to short counter-shafts located near each side wall and from these counter-shafts down to the several tools. On the left are first the air reservoir, which is supplied by a double pump mounted on the top of it; then the lathe, grindstone, upright drill and forge. On the right is a bench carrying the vises and at one end an emery wheel and blower. To the left of the motor is a space

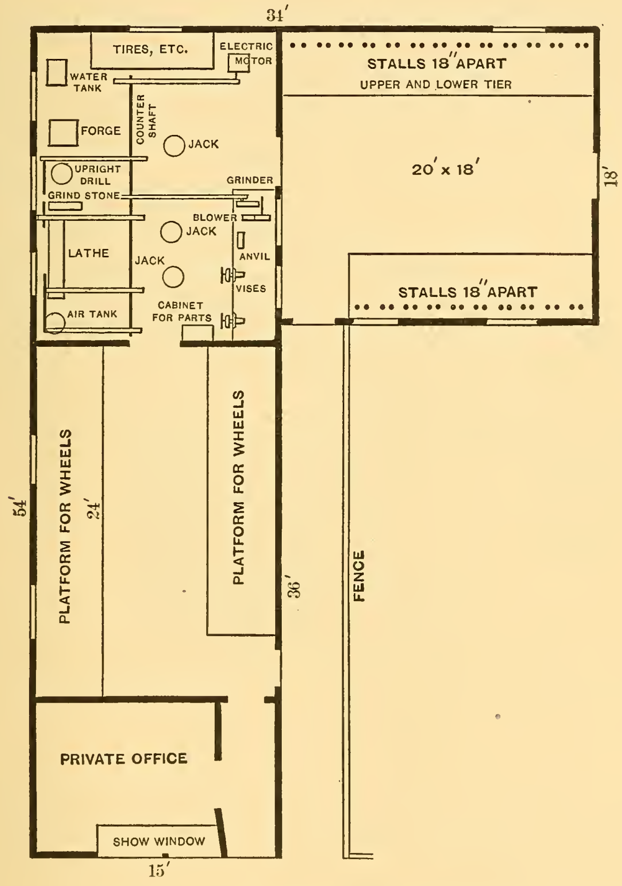


Fig. 3.—Repair Shop in Special Bu'lding.

devoted to tires and still further to the left is the water tank. In the center of the room are jacks for holding Bicycles.

The spaces between the windows and under the bench are taken up with shelves and drawers for holding wheels and the parts kept in stock. The cabinet indicated at the entrance contains all the parts of the wheels for which the repairer is agent. These are carried in order that any needed repair may be made as quickly as possible.

The extension at the right of the rear of the main building is 18 x 20 feet. At one side is a double bank of stalls and at the opposite side a single row. The stalls are placed 18 inches apart, and each is formed of two uprights about 2 inches in

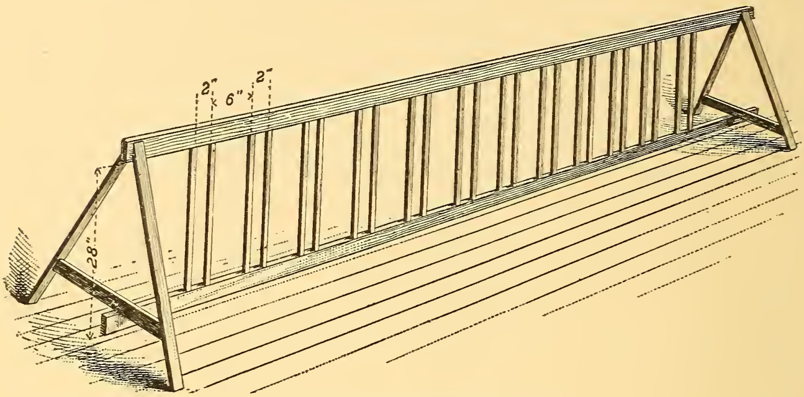


Fig. 4.—Rack for Holding Bicycles.

diameter and spaced just far enough apart to permit the entrance of a wheel between them. In this room the wheels needing repair and those for rent are kept.

Rack for Holding Bicycles.

It is essential in every shop, no matter how large or small, to provide means for holding wheels, whether they are for sale, rent or to be repaired. Preferably, the arrangement should be such that the wheels will occupy the least possible space. The rack shown in Fig. 4 is a very common form and serves the purpose well. It may be made stationary, as in the case of the two shops just described, or movable, as in the illustration. The space assigned to storage purposes may to advantage be fitted with a railing of any desirable length—room permitting, of course—placed so that it will accommodate a row of Bicycles upon either side The uprights of the railing are conveniently made of 1-inch stuff, cut about 2½ inches wide and spaced as follows: Two inches between the first pair of uprights, then 6 inches of space; after this another pair of uprights 2 inches apart, then 6 inches of space, and so on over the desired length of railing. There should be horizontal bottom and top railings running the entire length of the structure to strengthen it, also two side braces attached to either end from the upper rail to floor and making the stand more rigid. The railing should be made 28 inches high. The Bicycles are placed with their front wheels in the 2-inch spaces alternately on either side of the rack or railing.

Utilizing the Ceiling.

A method of supporting a Bicycle from the ceiling, either for inspection, cleaning or storage, is shown in Fig. 5. Fixed

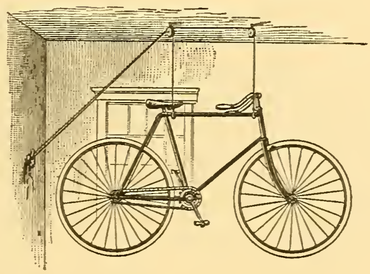


Fig. 5.—Utilizing the Ceiling.

in the ceiling are two small pulleys, one of which, that to the right, is single and the other double. Two cords are strung through these pulleys, as indicated in the drawing, and to the ends of the cords are fastened hooks which hold the wheel. When the wheel has been raised to the desired hight the cords are made fast to a cleat on the side wall.

CHAPTER II.

Stands for Holding the Bicycle.

While the work of dismantling the Bicycle can be performed with the machine placed upon the floor, or upon a low table of a size just sufficient to hold it so as to permit of its being conveniently approached from all sides, it is better to

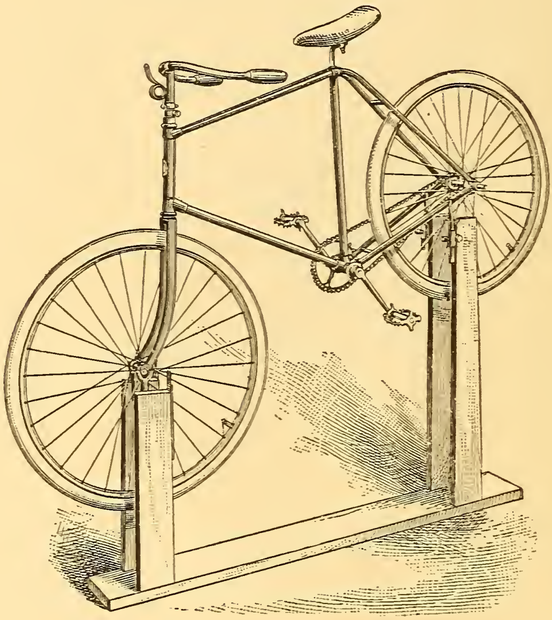


Fig. 1.—Supporting Bicycle at Bearings.

have some arrangement for holding it securely in an upright position. Several of the devices about to be described are of home construction. All are of extremely simple design and inexpensive. The one shown in Fig. 1 supports the Bicycle in an upright position at the hubs or bearings of the two wheels. It consists of a baseboard, near each end of which are secured two uprights or standards. Projecting upward from the top of each standard is a forked bar which may be adjusted either up or down. The forks of the front pair of standards are adapted to receive the outer ends of the front axle of the wheel, the rear pair receiving the two lower side bars of the frame. The base

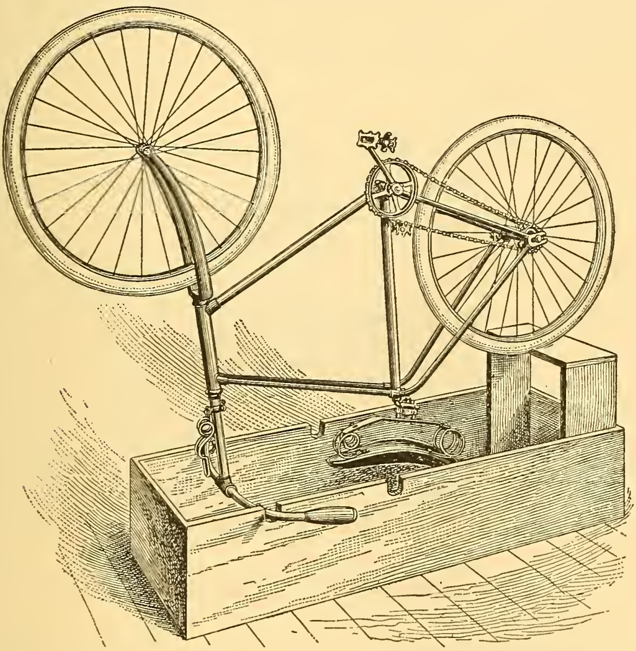


Fig. 2.—Stand for Holding Bicycle in Inverted Position.

of the rack is nailed to the floor in order to hold it firmly. This device brings all parts of the wheel within easy reach of the workman, and holds it until every part has been removed except the fork. An advantage possessed by this stand is that it interferes in no way with the turning of either the front or back wheel. During an inspection of a wheel brought in for repair it is often desirable to turn either or both wheels as a help to finding out just where the trouble lies.

Stand for Holding Bicycle in Inverted Position.

The second stand, Fig. 2, is designed to hold the wheel in an inverted position. It consists of an oblong box about 12 inches deep and without top or bottom. It is about 14 inches wide by 40 inches long. Sunk into each upper edge of the sides are two grooves or notches placed directly opposite each other. The front pair of notches are about 6 inches from the end of the box, the other pair being nearly in the center. These notches are intended to receive the handle bar of the Bicycle, as shown

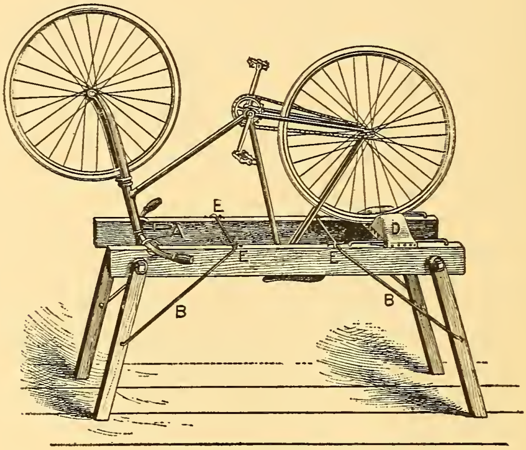


Fig. 3.—Folding Bicycle Stand.

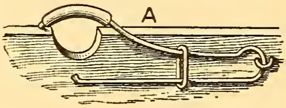


Fig. 4.—Enlarged View of Clip A.

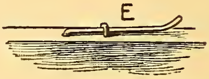


Fig. 5.—Enlarged View of Clip E.

in the engraving. At the rear end of the box are two standards projecting to about twice the hight of the box, and united by a cross piece on top. In the center of the front edge of this cross bar is a round recess, formed to receive the rear wheel. As the base of the box is comparatively broad it is not necessary to nail it to the floor.

Folding Bicycle Stand.

The stand illustrated in Figs. 3, 4 and 5 may be folded and hung up out of the way when not in use. The frame is 32 inches long, 11 inches wide and is made of 1 x 2-inch hard wood. The legs are 12 inches long, and at one end are pivoted to the side bars of the top. The spring clips A, shown enlarged in Fig. 4, are intended for holding the handle bar, which rests in notches made in the upper edges of the side bars. The curved part of the clips are incased in a rubber tube so as not to injure the handle bar. The U shaped braces B are attached to the

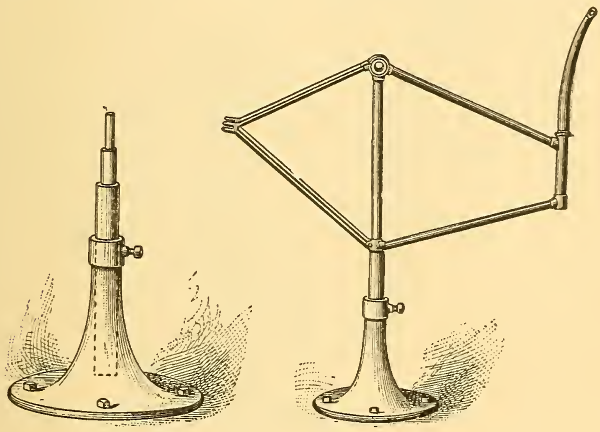


Fig. 6. Fig. 7.

Simple Bicycle Stand.

legs near the bottom and their connecting portions enter notches in the frame, being held in position by the clips E, Fig. 5. When the braces are released from their spring clips, the legs may be folded against the under side of the frame. The seat D is cushioned and is arranged to slide so as to accommodate wheels of different size.

Column Stands for Holding a Bicycle.

In the stands now to be described the Bicycle is held upon a bar projecting from a base and entering the seat post. One of the simplest forms is shown in Figs. 6 and 7, which consists of a plain round base, either of wood, or preferably of iron, with a spindle in it, which is turned down for a distance of about 4 inches to fit all the standard size seat post holes in standard makes of frames. (This spindle may be made adjustable for hight by the set screw in the base.) The frame is then put on

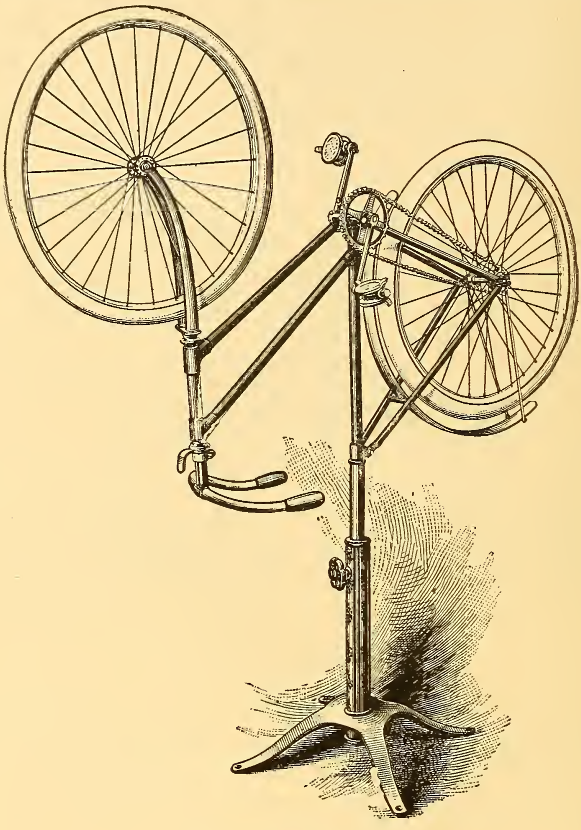


Fig. 8.—Show Stand.

this spindle, bottom side up, as in Fig. 7, in which manner all the bearings in the forks can be taken out and put in, name plates put on, wheels and crank shaft bearings adjusted or trued and chain adjusted ; in fact, nine-tenths of the work in assembling or repairing may be done on this same spindle.

Show Stand.

The stand, Fig. 8, differs from the one just described, mainly because it is composed of a common show stand such as is used in many trades to display goods upon. Sliding in the standard projecting from the base is a tube, which may be clamped at any desired hight. The center bar of the frame passes over this tube.

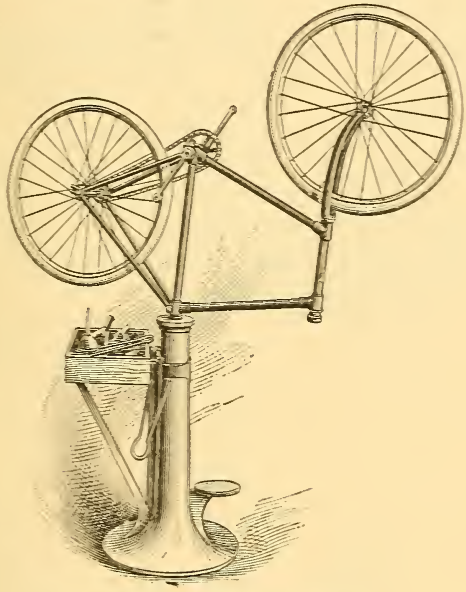


Fig. 9.—Home Made Stand.

The principal fault to be found with this stand is the lack of weight in the base. There is no solidity to the device, and it is very apt to be knocked over unless screwed to the floor.

Home Made Stand.

The stand shown in Fig. 9 has one important advantage—it is home made. All the parts necessary for its construction can be obtained in almost any town, and it can be made with the tools found in any repair shop. The stand is formed of a cast iron column, such as is used for a great many machines.

The hole in the top is plugged with hard wood or iron, and in the center of the top is inserted a bar small enough to enter the center tube of a Bicycle, and 3 or 4 inches in length. The wheel

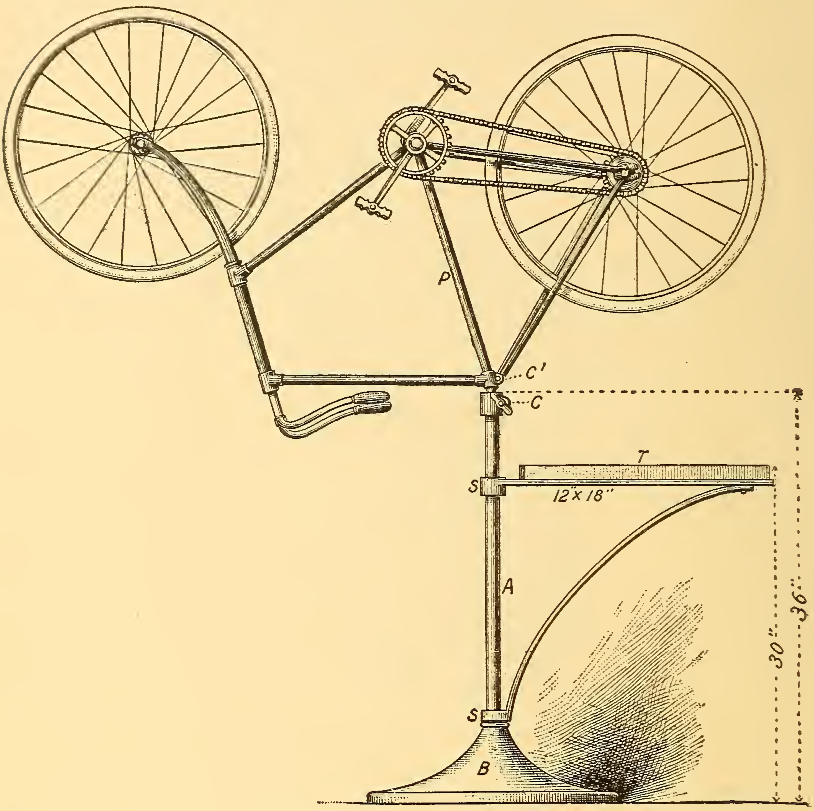


Fig. 10.—Stand with Table.

is held by this bar, as shown in the engraving, at such a hight as to bring all parts within convenient reach of the workman. The stand formerly described was provided with a clamp by means of which the Bicycle could be held rigidly in any desired position. This stand could be furnished with a similar device if thought essential.

A still simpler stand, and one that would serve every purpose, could be made of a piece of 1 inch gas pipe, mounted in a heavy block of wood. In the top of this pipe should be inserted a small pipe or bar about ⅜ inch in diameter by 4 inches long, for entering the center tube of the frame.

Stand with Table.

The stand, Fig. 10, consists of a cast iron base, B, screwed to the floor, fitted with a hollow wrought iron column, A, around

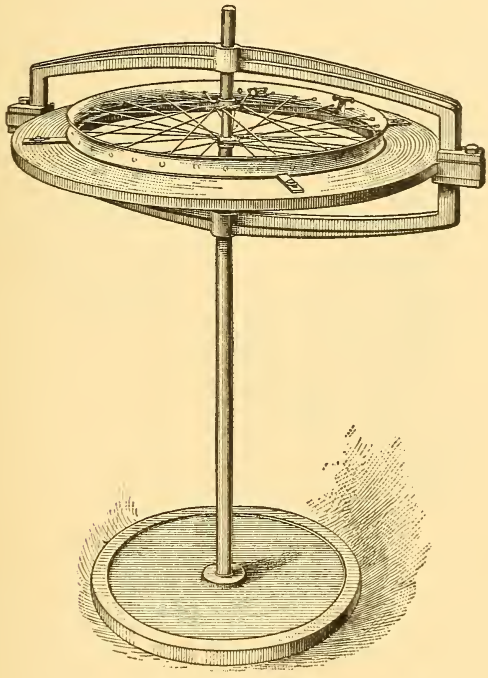


Fig. 11.—Stand with Flat Cast Iron Base.

which swings, entirely free, and supported by a bracket, S, a table for holding tools. The column is fitted with a clamp, C, at its upper end, clasping a movable post, which, if required, is bent to bring the Bicycle, when fixed thereto, to a horizontal position, as indicated by the drawing. The Bicycle to be operated on has its seat post removed, is inverted and placed upon the post of the stand. After adjusting the frame to the desired position the seat post clamp C′ and the socket clamp C are tightened, when the Bicycle is ready for operations. At times it may be desirable to remove the front fork and front wheel, and after clamping another larger rod into the socket C to pass the socket head or steering head over the rod and perform the required repairs with the frame in this position.

Stand with Flat Cast Iron Base.

An extremely simple and efficient stand is shown in Fig. 11. The base is 26 inches in diameter and is merely a casting weigh-

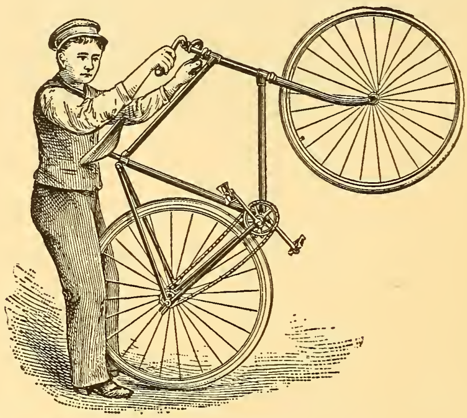


Fig. 12.—Another Method of Holding a Bicycle.

ing about 60 pounds. In the center is a threaded hole in which a 1-inch gas pipe is inserted, forming the standard. The circular form of the base permits of the easy rolling of the stand from one location to another, while the comparatively great weight of the base insures its maintaining an upright position Further than this, the stand may be very cheaply constructed, as the base can be obtained from any foundry without the necessity of furnishing a pattern, and the gas pipe can be mounted by any plumber or gas fitter.

Another Method of Holding a Bicycle.

The engraving, Fig. 12, requires but little explanation. The repair shop should have the services of a bright lad, particularly one who is both quick and ready, and who has an ambition to thoroughly learn the trade and to some day own his own shop, and, perhaps, to take the lead as a Bicycle manufacturer.

CHAPTER III.

Brazing.

One of the most important operations connected with the making of a Bicycle is that of brazing. Every frame now on the market is composed of several parts united so as to form a single piece by means of brazing. The integrity and usefulness of the frame, and therefore of the wheel itself, depend upon the degree of perfection of the work done upon the joints. If this is not skillfully done, or if any one joint of the many is not made properly, then the wheel is doomed to speedy destruction.

To be convinced of the really superior work performed in this line by the Bicycle manufacturer it is only necessary to examine a lot of broken frames. Not in one case in twenty—and we are perhaps safe in saying not in one in a hundred—will the fault be found in the brazed part. Breaks occur next to and far from the joint, but very infrequently do they take place in the joint proper. The repairer should fully appreciate the fact that this uniformity of result is not reached because the work is easy, and he should not be led to assume false confidence because the operation appears to be so simple and because the appliances needed are seemingly so crude.

Skill and experience are the most essential requisites of a brazing department. These must be supplemented by the integrity and conscientiousness of the workman. Holding two pieces of metal together, heating them, and applying a flux and a solder will not always produce a brazed joint. There are other things needed. If two strips of thin metal are lapped upon each other and the meeting parts brazed the joint may or may not be a good one. An examination of the edge may indicate that the joint has been closed nicely all around. At the same time the joint may be pulled apart with the hands.

All the inspection possible and the closest scrutiny from the outside will not convey much knowledge of the true worth and condition of the joint The real strength of the joint is out of sight in the interior. When the meeting surfaces have been united by the proper heating of the metal, and when the brazing solder or spelter has flowed completely, the joint may be considered as perfect. Cutting through the joint is the only way of ascertaining if this has been done; looking at the exterior gives only an indication, but nothing positive or definite. It is for this reason that the past experience of the operator plays such an important *rôle*, and this also explains why he should be careful and honest in his endeavor to produce good work. His training tells him when the joint has been brought to the proper temperature and when the entire joint has been heated evenly through and through. He also is certain when the brazing spelter has flowed perfectly. Work he has done in the past is the guide he follows at the present time. Not having this training the novice must work in the dark. It is advisable for the beginner to practice brazing on some old tubes before attempting this kind of work on a Bicycle.

In the following divisions of this article on brazing several different kinds of brazing furnaces are considered first, followed by accounts of the fluxes and brazing spelters or solders, and their action discussed. This arrangement is thought to be best, as it presents the necessary appliances first and their manner of employment second.

Brazing Furnaces.

It may be assumed that furnaces using gas (ordinary illuminating) or vaporized hydrocarbons, such as gasoline or petro-

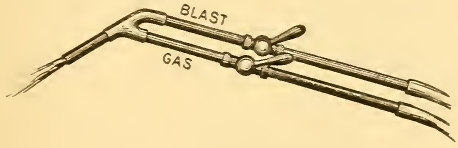


Fig. 1.—The Bunsen Burner.

leum, are constructed upon the principle illustrated in Fig. 1. In this the blast of air and the gas unite before leaving the nozzle. In each pipe is a valve to regulate the flow of both gas and air. Before the air and gas leave the burner they are mixed,

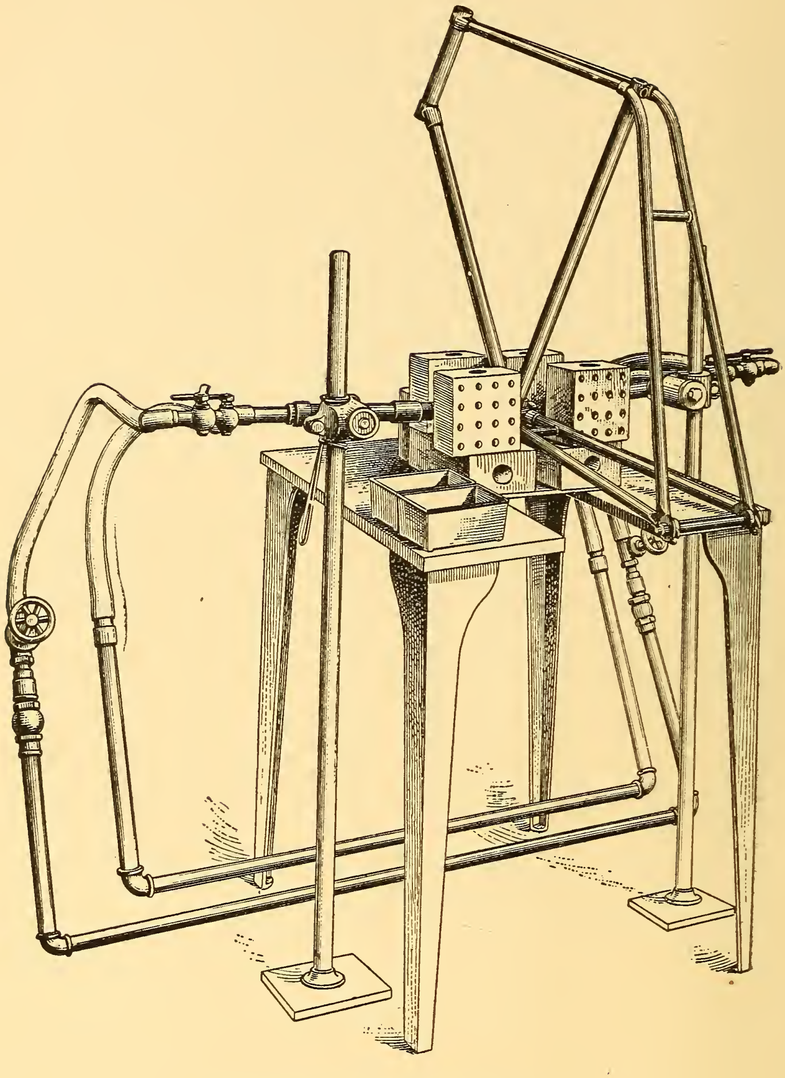


Fig. 2.—Large Brazing Furnace.

and the perfection of combustion depends very largely upon the thorough intermingling of the two. This action will be more readily understood from the descriptions which are to follow.

In the brazing furnace shown in Fig. 2 the two main pipes conveying air and gas, respectively, are united in the burner in the usual way. Each nozzle is carried in a bracket, which may be adjusted to any hight to bring the flame at the desired distance above the table, as will be understood by reference to the drawing. Resting upon the table, which is a simple construction of cast iron, are the fire bricks, which are so arranged as to confine and concentrate the meeting flames of the two burners upon the work in hand. In this case the fire bricks are made of perforated cast iron, shaped as indicated, this construction and material having been found preferable to those ordinarily made of fire clay.

Brazing Furnace Without Fire Bricks.

The furnace shown in Fig. 3 is very similar in design to the one just described. The table is a simple cast iron affair of the form plainly shown in the engraving. At opposite sides of the top are standards upon which sleeves slide freely. These sleeves are held at any desired hight by the thumb screws shown. Each sleeve carries a burner to which the gas and air pipes are connected, and each of these pipes is provided with the usual valve for regulating the flow. The two burners can thus be adjusted so that the meeting points of their flames will be at any required hight above the table.

This furnace differs from that before mentioned chiefly in the method of operating it. No fire bricks are placed so as to form a pocket to receive the article to be brazed. The burners are much larger than the others, this being done in order that the article may be completely enveloped in the flame.

We do not find that an open furnace of this kind is used very extensively, most of the brazing being done with the aid of fire bricks. But those who do use it claim that they can do better work, and that with an open flame there is less risk of injury to the steel by hurtful ingredients uniting with it. It is claimed that although the piece is entirely surrounded by the flame there is a current of air which tends to remove constantly the dangerous elements which might come in contact with the metal if the flames were confined. A further claim for this furnace, and one which has much more foundation in fact, is that the work is not partially hidden. It is in plain view from all sides and its exact condition can be found without removing it

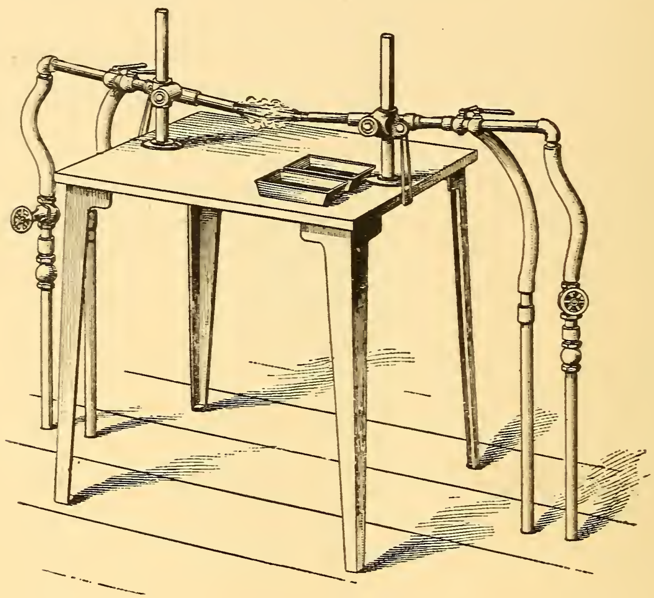


Fig. 3.—Brazing Furnace Without Fire Bricks.

from the flame. In addition the flux and brazing solder can be applied without trouble.

Four-Flame Brazing Furnace.

The brazing furnace shown in Fig. 4 possesses very decided advantages over those described previously. Its construction is so plainly brought out in the engraving that only a brief description is required. The air and gas pipes are bent to about three-quarters of a circle and are arranged one above the other, that supplying the air being above the other. From the upper circle four tubes project radially to within a short distance of the center. These tubes are united with the lower circle by the tubes shown. This provides four Bunsen burners placed at equal distances apart in a circle, and each directing its flame toward a common center. The flames are controlled in the usual manner by means of the valves indicated. These burners can be worked independently or all together, according to the heat required by the work in hand. When operated together the piece is perfectly enveloped in flame and any desired temperature can

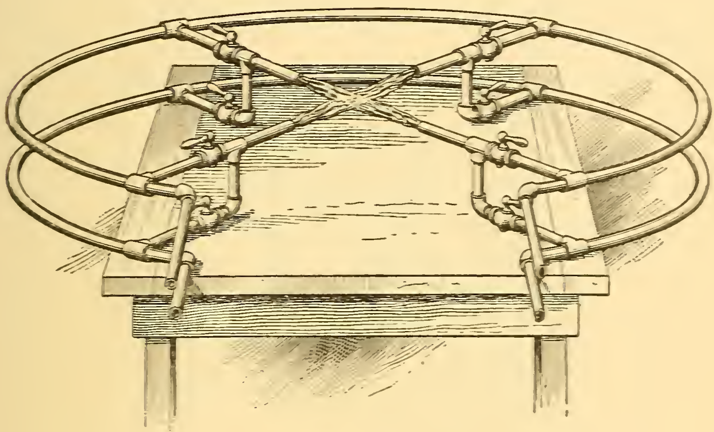


Fig. 4—Four-Flame Brazing Furnace.

be obtained. Further, the heat is concentrated and delivered upon all sides of the joint, insuring an even heating of the metal by the direct contact of the flames.

The furnace evidently admits of wide modifications while still preserving its distinguishing characteristics. If an opening were cut in the top of the table to a point beyond the center, a Bicycle frame could in some cases be handled much easier, and the point could be brought to the position most favorable for doing the work. With a solid top this is not always possible. Placing the rings upon legs and doing away with the top would be a still better arrangement. A further advantage in some instances would result if the burners were so placed that the flame could be directed up or down or at any desired inclination to the plane of the rings. This would permit of a wider distribution of the flame and the heating of a larger piece.

A Simple Brazing Furnace.

With the aid of the engravings, Figs. 5 and 6, the repairman can construct for himself a furnace with which he can perform all the brazing required.

It consists of four valves, four quarter couplings and differ-

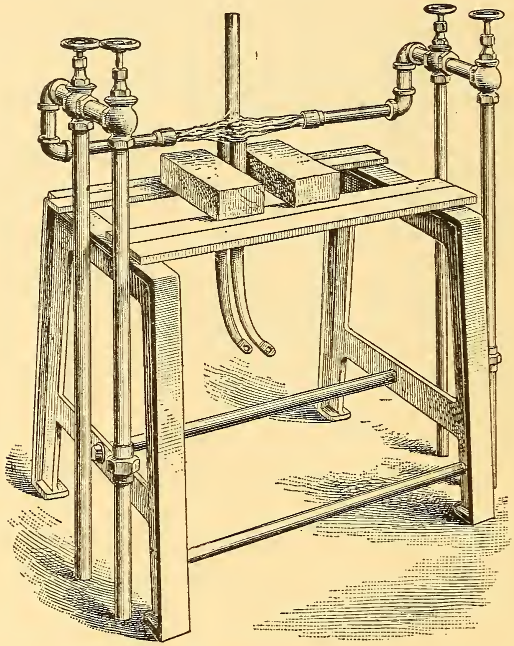


Fig. 5.—A Simple Brazing Furnace.

ent lengths of gas pipe. All the parts can be purchased at any plumbing establishment, where the pipe can be cut to the lengths required and the ends threaded. A pair of pipe tongs is the only tool needed to assemble the parts.

The stand consists of two cast iron frames held by rods and having boards placed across the top. Where frames of this kind could not be conveniently obtained, wooden frames could be made that would serve just as well. The cross pieces on the top should not be fastened to the frames, as it is often necessary to shift them in order to accommodate different kinds of work. The stand may be made 30 inches high, 24 inches wide and 24 inches deep. These dimensions can, of course, be changed if thought desirable.

Referring now to Fig. 6, all of the pipes are 1 inch in diameter. The air pipe K and the gas pipe J lead to the air and gas supplies respectively. The pipe H may be 4 inches long, and the pipes F and D 2 inches. The burner pipes B should be of such length as to bring the outlets or nozzles A about 9 inches apart. These pipes will vary in length according to the width of the stand and the distance of the pipes J and K from

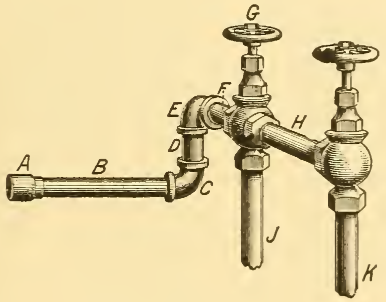


Fig. 6.—Detail of One Burner.

the edges of the stand. On the end of the burner pipe B is a reducing couple which reduces the opening to ½ inch. Instead of the valve G, which controls the flow of gas, being arranged as shown, the two pipes F and H could be united by a T and a straightway valve placed between the stem of the T and the pipe J. Perhaps the only object of this construction would be to cheapen the cost a trifle.

It will be noticed that the two quarter bend couplings C and E could be dispensed with and the pipe F extended to form the burner. The supply pipes J and K would then be placed at right angles with the sides of the stand instead of parallel, as they are in the engraving. The burner would then be held rigidly in one position, and it would not be possible to adjust the flame to suit different kinds of work. This would be a most serious objection and would limit the usefulness of the furnace. But by following the construction shown the burner is practically mounted upon a universal joint and the flame can be

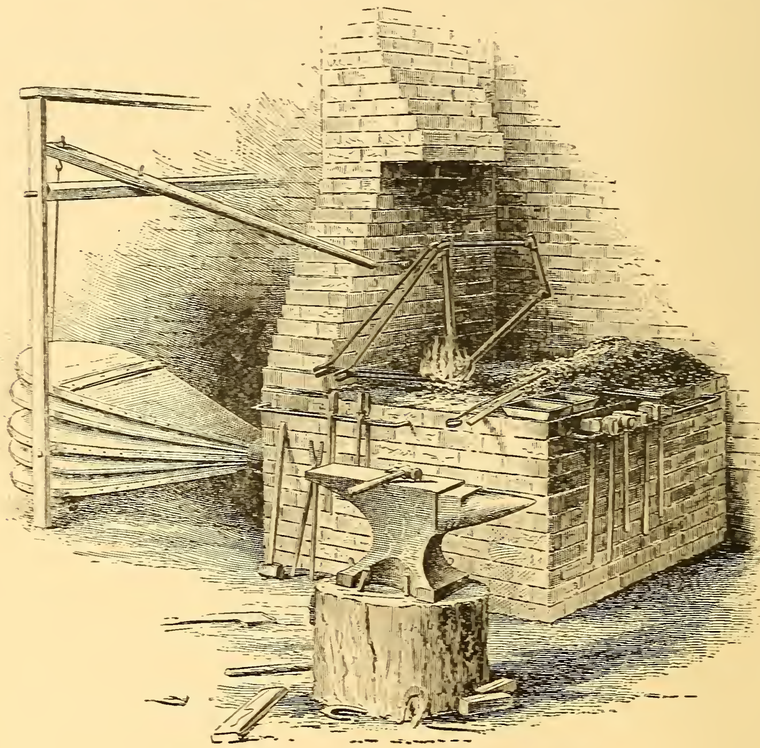


Fig. 7.—Brazing with Old Fashioned Forge.

directed toward any desired point. The horizontal movement of the burner can be made about the pipe D and its vertical movement about the pipe F. Without this range of adjustment the piece being brazed would have to be supported on fire bricks to bring the joint at the meeting point of the two flames. This would be troublesome and sometimes difficult.

Brazing with Old Fashioned Forge.

With the old fashioned blacksmith forge, as shown in Fig. 7, brazing can be done, although the operator works under many disadvantages. In the first place the work or joint to be brazed is more or less hidden by the fuel used, and, therefore, its exact condition, as far as its heating is concerned, cannot be as readily ascertained as when the work is done in the furnace using flame, as previously described. This is a very essential point, because the metal in the tubes is so thin that unless the heat is watched very carefully there is danger of burning by overheating, but where it becomes necessary to braze with a forge of this description, and where ordinary soft coal is used it would be well to start the fire and run it some time before brazing the joint in it, in order to burn out, as far as possible, those elements in the coal which would be likely to injure the steel by forming a union with it. After the coal has been burned so that the flame looks bright and clear the joint can then be introduced. A better fuel to use for this purpose is coke, or perhaps the best is charcoal. With the latter there would be practically little or no danger from the presence of hurtful ingredients. Our engraving of this forge is merely produced in order to show that even with the crudest apparatus brazing can, when necessity calls for it, be done. With the small portable forges in which the blast of air is derived from the rotary blower much better work can be done, because the forge, considered as a whole, is more convenient for the operator and more thoroughly under his control.

Heating a Joint.

The drawing, Fig. 8, serves to illustrate an experiment which it would be well for those who have had no experience in brazing to try. Two pieces of sheet steel are lapped over each other, as shown, and are held in contact with each other by wires wound around each end. The flame of a Bunsen burner is then directed against one side, as indicated. It will be found that the piece immediately under the flame heats rapidly and becomes red hot before the under piece does. The joints of a Bicycle are formed on practically the same principle—two pieces of tube, one within the other. This joint should be heated evenly throughout, and to accomplish this the part must be held in the flame some time after the outer layer of metal has reached the heat necessary for brazing. Of course the thickness of the metal and the closeness of the two parts to each other will have an influence on the length of time required. If the overlapping parts are very thin and touch each other all over, the inner part will follow the other very quickly in reaching the required temperature. It should not be taken for granted that because the edges are heated sufficiently to receive the brazing solder the inner surfaces are in the same condition. And yet, in order to make a perfect joint, the pieces must be heated uniformly throughout. A crude idea of the time needed may be obtained by repeating the experiment with different

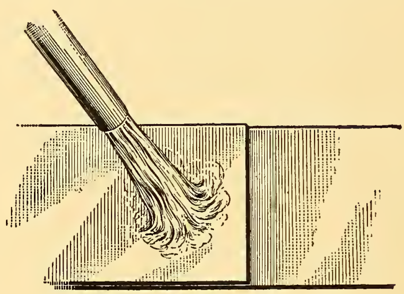


Fig. 8.—Brazing Experiment.

thicknesses of steel and having a larger and smaller space between the surfaces.

Fitting Parts for Brazing.

We have not as yet said anything regarding the desirability of fitting together accurately the parts which are to be united by brazing. If the joint is left comparatively open, and the brazing solder is depended upon to fill the recesses between the surfaces, the job will be lacking in strength and will most certainly be a source of trouble later on. Other things being equal, the thinner the layer of solder uniting the surfaces the stronger the joint. The strength of the steel is vastly greater than that of the solder, and when the latter is present in any considerable quantity, as in a poorly fitted joint, the strength of the union is only that of the weaker member. Too much care, therefore, cannot be expended in the fitting of the parts before brazing.

The fear that the solder will not flow to and cover all parts in a well fitted joint has but little foundation in practice. The enlargement of the outer part, a tube for instance, due to expansion as it heats, will separate the parts sufficiently to permit the flux to flow freely over the entire surface, and it may be accepted as axiomatic that where the flux flows the solder will follow.

Another and most essential requisite is the cleanliness of the surfaces, which should be absolutely free from even a trace of dirt of any description. The surface should be bright and smooth. The practice, fortunately not very common, of roughing the surfaces with a coarse file, under the impression that the ridges thus formed will aid in holding the solder and add to the strength of the joint, is a pernicious one. Doing this actually reduces the strength, as a greater quantity of solder is admitted than would be the case if the surfaces were finely finished. Any one can easily demonstrate this by brazing together two smooth pieces and two rough pieces, all the other conditions as to material, size of joint and manner of holding being similar.

When the heat is applied to a joint ample time should be allowed for the piece inside to reach the proper temperature. If this inside piece, as in a forged crank shaft bracket, is considerably heavier than the outside one, it will require some time longer before it reaches the proper degree of heat. It is far safer to keep the joint in the flame for too long a period rather than too short. When the two pieces are of the same thickness, it is far easier to make a perfect braze, because the inner tube follows more closely the outer one during heating and reaches the brazing temperature at almost the same time.

The majority of manufacturers and repairers pin the parts in order to hold them during the operation of brazing. A few depend, when possible, upon holding the parts together by wrapping wire around them. Good work cannot be done by this latter method, since the parts cannot be held in close enough contact.

The method followed by the builders of a well-known Bicycle in making their crank shaft brackets very clearly emphasizes the points we have endeavored to bring out. This bracket is illustrated in its rough form in Fig. 9.

The parts to receive the ends of the tubes are first fitted to the large main tube with the utmost nicety, and a bright finish is given to the meeting surfaces. Four equidistant holes are then bored through each flange and through the main tube, the parts being held together firmly. Each hole is then tapped

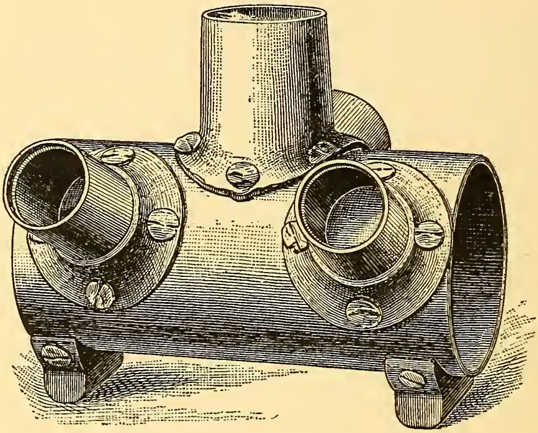


Fig. 9.—Fitting Parts for Brazing.

and a screw inserted. The projecting inner ends of the screws are then cut off, and as a further precaution the screws are upset or riveted down. It is very evident that this plan insures the rigid holding of the parts together during brazing, and guarantees the making of a perfect union. After brazing, the edges and screw heads are filed down.

Flux for Brazing.

In Bicycle work borax is the flux most generally used, and it can be purchased from any of the supply houses dealing in this class of material in one of three forms: The plain borax, borax which has been dried or calcined, or borax which has been melted and then broken to the form of a coarse powder or granulated condition. It would be well for the novice in brazing to experiment with these three forms. He will find that the first swells and bubbles under heat in a remarkable way, and does not flow readily over the surface. More important, it seems to constitute a barrier, tending in a more or less perfect degree to keep the brazing solder away from the steel. The second form will be found to be nearly free from this defect, and for that reason to be preferable. The third, or granulated borax, has had all the water driven out of it, and it therefore forms an exceedingly perfect covering for the metal. We therefore find that a common practice is to use some of the calcined borax and some of the melted borax, with which the joint may be covered. The principal work done by the borax is to protect the joint or surfaces of the metal from the action of the flame, so that when the solder is applied the surface will be perfectly clean, and a metallic union or contact may therefore be formed between the meeting surfaces of the steel with the solder interposed as the binding material. It will therefore be understood that the perfection of the work depends in a large and perhaps vital degree upon the true cleanliness of the two surfaces at the time of the application of the solder

The principal reason for using borax is because it is not dissipated or thrown off by the high heat necessary for brazing, in addition to the perfect protection it affords. The application of both the borax and solder are continued until the joint has, in the opinion of the workman, been covered in all its parts by melted solder. It is at this point that the experience of the workman and his skill in the application come to his assistance. He can readily tell by observation when the outer joints have been united, but the inner and hidden surfaces he can only estimate from his past work and the general appearance from the outside. There is no absolutely sure rule that will enable one unskilled in this work to make a joint of the best kind. As we have said previously, the best drill is to braze a couple of tubes and then saw them apart parallel with the axis, and observe the quality of the work in that way. A few examples of this kind would give the workman a knowledge that he can acquire in no other way.

It must be remembered that if the steel is heated to too high a temperature, or if it is exposed for a long time to a comparatively low heat, its quality will be impaired. The work should therefore be done as quickly as possible. By this it is not meant that the joint should be placed in an intensely hot flame in order to bring it rapidly to a brazing temperature. This might result in injury to the outer tube. The joint should be heated just sufficiently for brazing, and it should be heated only long enough to do the work.

Brazing Solder or Spelter.

The principal ingredients of brazing solder, hard solder or spelter, terms which appear to be used indiscriminately, are

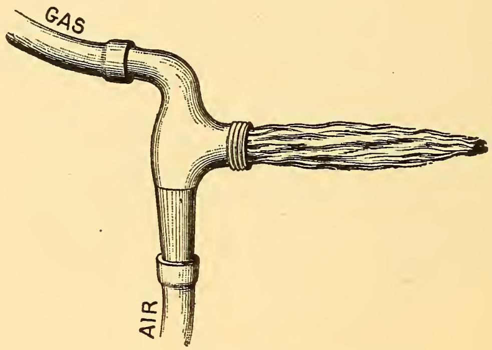


Fig. 10.—A Simple Bunsen Burner.

copper and zinc, the proportion of the latter governing the hardness of the solder.

As brazing solder can be purchased of any desired composition, according to the work in hand, it is not necessary to discuss the different kinds.

Cleaning after Brazing.

Looking at the brazed frame after it has come from the brazing furnace it will be noticed that the flux has flowed over the surface and covered parts adjacent to the joint, but having no connection with the joint proper. It is of the greatest importance to remove every trace of flux, and in doing this it is found to be a very common practice to use the sand blast, in which sharp sand is blown against the joint by means of air under pressure. This removes the flux and leaves the surface clean for the reception of the enamel. If the flux is not very thoroughly removed the enamel will peel off at those points. The surplus solder is removed by filing and the use of emery cloth.

A Simple Bunsen Burner.

The Bunsen burner shown in Fig. 10 is easy to make and should cost only a trifling sum. To the ends of the bib cock,

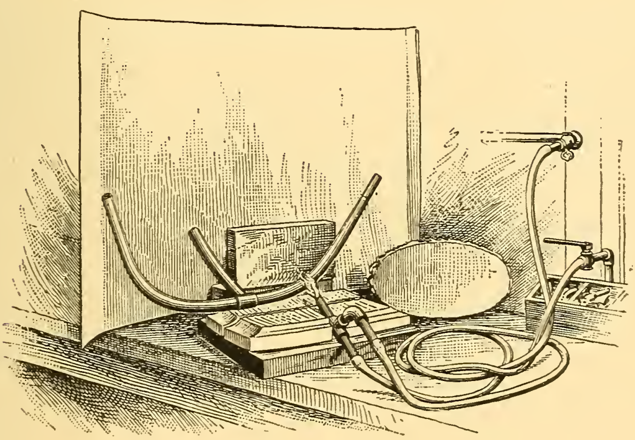


Fig. 11.—Convenient Heating Apparatus.

which can be bought of any plumber, are attached rubber tubes for the gas and air. The efficiency of the burner would be increased by screwing a short length of pipe on the outlet. In using this burner care must be taken to so regulate the air pressure that the gas will not be forced back. When the air pressure is largely in excess of the gas pressure the burner will be useless, as the air will choke off the gas.

Two Convenient Bunsen Burners.

The two arrangements shown in Figs. 11 and 12 will be found very convenient for brazing small articles, or for soldering. The gas and air pipes are several feet long, thereby permitting the flame to be taken to the work, say to a Bicycle mounted on a stand. From an ordinary Bunsen burner, Fig. 11, lead two rubber tubes which are connected to the gas and com-

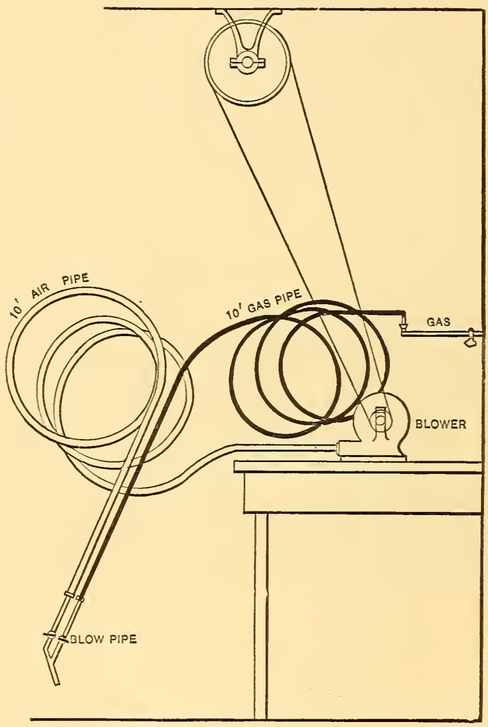


Fig. 12.—Convenient Blow Pipe.

pressed air pipes which project from the wall at the back of the bench. The tubes are long, so that the flame can be applied to work placed several feet from the permanent supply pipes. On the bench is a flat piece of cast iron, upon which the fire bricks are arranged in the way best calculated to confine the flame to the piece to be heated. A curved tin screen is placed on the bench back of the bricks. With this appliance any small job requiring heat can be performed. Heat is required by so many of the operations of building and repairing Bicycles that the handy arrangement of a burner is of importance.

In the next burner, Fig. 12, a rubber hose pipe leads from the gas bracket at the side of the wall above the bench to the blow pipe. This is shown by the heavy black line. The air pipe, indicated by the two light lines, extends from the blower placed on top of the bench to the blow pipe. The blower is driven from an overhead shaft, as indicated. As both the air and gas pipes are 10 feet long the flame can be taken to any job in the clear space in the middle of the room. In many instances this is of great importance, as the work is made easier by bringing the flame to the job instead of having to carry the job to the flame.

It should be noted that the most essential difference between these two arrangements is in the source of the air supply. In the first it is obtained from a tank or reservoir which is filled with air, kept at a uniform pressure. In the second form the air is obtained from the blower, which is only in operation when the flame is needed. The first plan, of having the air always on tap, so to speak, is by far the better method, but as it requires an air pump, or pressure blower and a tank, it cannot be placed in every shop

CHAPTER IV.

Tempering and Case Hardening.

Tempering and case hardening are important operations, which find a wide application in the repair shop. We shall first take up the subject of tempering and follow with case hardening.

To properly temper a piece of steel requires skill and long experience in order to obtain the best results, and although the novice cannot expect to reach the most perfect results at first, he can by repeated trials and by closely following certain

Fig. 1.—Reamer.

necessary directions produce tools having cutting edges that will answer every purpose. Different grades and kinds of steel require different treatment; to determine beforehand exactly how to temper a tool made of steel, with the working of which

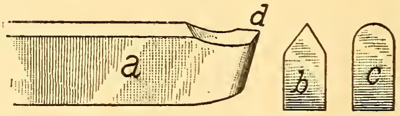


Fig. 2.—Lathe Tool.

the operator is not familiar, calls for unusual skill on the part of a man who has had a long and wide experience.

The tools shown in Figs. 1, 2 and 3, representing respectively a reamer, diamond point and round nose lathe tool, and twist drill, were selected only to point the directions following.

The first requirement is to heat the tool thoroughly and evenly, and not to any greater temperature than is needed to produce the object aimed at. A few trials with the same quality of steel will show which color, as indicating the degree of heat, will best serve the purpose. By heating evenly, we mean that sharp points such as *a a* in Figs. 1 and 3, and *d* in Fig. 2, should not be heated before the thicker body of the metal. If the tool is plunged into a hot fire such points will be unduly heated and burned and the tool ruined. Further, heating should be carried forward regularly and without interruption, and the tool should not be subjected to drafts of air. Rapid heating and cooling are injurious.

The forge fire (coke or charcoal) arranged for tempering and case hardening is shown in Fig. 4. The lever controlling

Fig 3.—Twist Drill.

the damper in the air blast pipe is shown to the right, and is within easy reach of the workman. The coal is banked up so as to form a dome, upon the top and sides of which are placed curved plates of thin iron, which serve to hold the coal in place. After the fire has been well started it is dug out at the front so as to form an opening in the incandescent coal. Care should be taken to leave plenty of coal above the tuyere openings. The pieces to be treated are then inserted in this opening, where they are completely surrounded by, but are not in direct contact with, the live coal.

The tools are first hardened by heating to a cherry red and then plunging in water. The edges are now so hard that a file will not touch them, and they are also too brittle for service. They are then heated to soften them, and it is this subsequent heating which governs the degree of hardness or temper of the tool, which is shown by the color. It is impossible to give explicit directions which may be followed to the letter; experiments must be made in order to become acquainted with the colors and their temperatures which give the most satisfactory results.

Case Hardening.

In case hardening the surface of the metal is made so extremely hard that a file will make no impression. While the hardest part is at the surface, the process can be so modified as to change the character of the metal to a considerable depth.

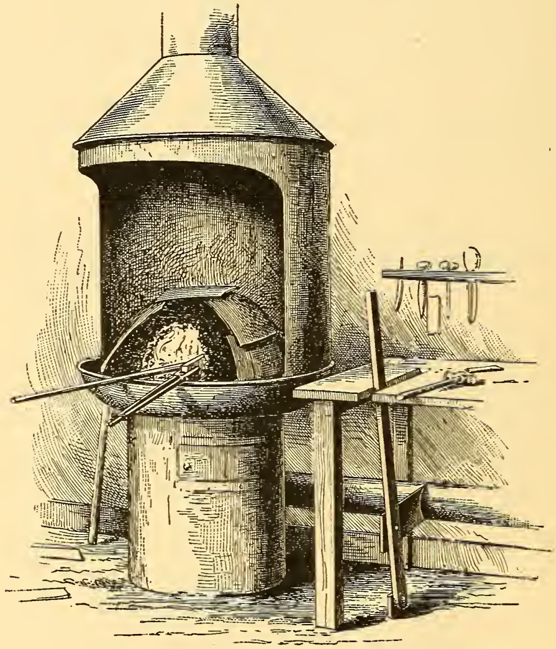


Fig. 4.—Forge Arranged for Tempering.

The method of doing this work is very simple, and with a little practice any article can be reliably hardened to the extent required. There are many parts of a Bicycle which can be hardened to advantage, such as screw threads, nuts, ball runs and similar parts which are subjected to wear either in the ordinary use of the wheel or in making necessary adjustments. It should be remembered that the chemicals here used are violent poisons, and they should therefore be handled cautiously.

In case hardening in an open fire, clean coke or charcoal should be used. A Bunsen flame, similar to those before described in the chapter on brazing, can be employed. In either case it is essential to heat the article slowly and uniformly to a dull red. If possible, the article should be completely surrounded by the fire, so that all parts may be equally subjected to the action of the heat. The best results cannot be obtained if the piece is heated only on one side at a time. As in tempering, the work should under no circumstances be made too hot, as there is danger of injuring the steel and as too great heat will not accomplish the object.

Two methods are here given. After the piece has been heated as described, it is removed from the fire and well coated with prussiate of potash. It is then held in the fire for about 30 seconds and then immersed in clean cold water. This method will produce colors similar to those obtained when case hardening with bone. If the piece has not been evenly heated throughout the potash will stick and fail to flow over the surface properly and the colors will not be present. For a greater and deeper degree of hardness the piece is first coated with cyanide of potassium and then the prussiate of potash is applied as before. To produce a dark gray color the piece is cooled in salt water.

Still another method of case hardening may be accomplished as follows: The pieces to be hardened are packed in a cast iron box in which is first put a layer of granulated bone, which can be purchased at almost any hardware store, then a layer of the work to be hardened, then more broken bone, and so on until the box has been filled. The top is then put on and the joint closed down with clay. It is required in using this method to keep the pieces at least ½ or ¾ inch away from the sides, top and bottom of the box. The box is then placed in the fire and heated to a good cherry red for from three to four hours, according to the depth of hardening required, and then the whole contents is dumped into cool soft water.

In order to produce color the bone should be thoroughly charred. This can be done by putting it into a cast iron box and subjecting it to a brisk heat until it has been transformed into charcoal. After the bone has been charred the work is packed for hardening, as above described. In this, as in all other processes, great care should be used in heating, but particularly where color is desired. If carried too far there will be no color. The best results can be obtained by heating to a cherry red and maintaining that degree without intermission.

For those who have had but little experience in hardening the telltale piece is recommended. This consists of a piece of

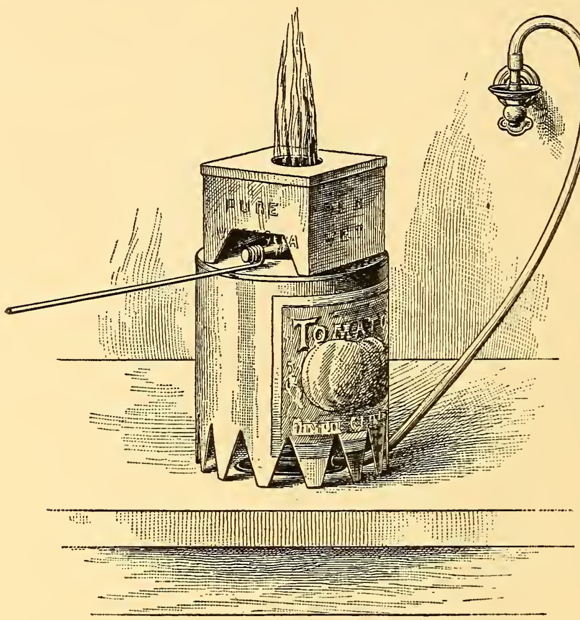


Fig. 5.—Unique Case Hardening Furnace.

round iron as nearly the size of the work to be hardened as possible, that reaches down into the center of the box and extends through the hole in the cover just enough to make a good grip for a pair of tongs. When it is thought that the work has been in long enough the telltale is removed without disturbing the pot and plunged immediately into cold water. If the telltale shows the work to be hardened to a sufficient depth the box is to be dumped as mentioned. It is, of course, to be understood that this method applies more particularly to cases where many comparatively small pieces are to be case hardened and that it cannot be economically employed where only one or two specimens are to be treated.

Unique Case Hardening Furnace.

A simple, cheap and effective case hardening furnace for small articles may be made out of two tin cans and a Bunsen burner, as shown in Fig. 5.

The tomato can had a hole cut through the closed end for the flame to come through, and was nicked around the edge of

Fig. 6.—Ladle.

the open lower end to let the air in and was inverted over the Bunsen burner. The tobacco box with a wide nick in one side was placed bottom up on the tomato can. The purpose of the tobacco box was to shade the light and keep off drafts and the tomato can was a convenient stand to hold the box above the burner. A long wire twisted about the thread of the key which

Fig. 7.—Home Made Tap.

was to be hardened made a good holder, and a narrow piece of tin, Fig. 6, served as a ladle for applying the prussiate of potash.

The steel key was heated to a cherry red and kept at that temperature for a minute or two to let it " soak "—that is, heat through. Then the prussiate of potash, in fine powder, was ladled on, the work being kept in the flame all the time. The potash will form a dark colored coating all over the steel, which must be plunged instantly into cold water on being withdrawn from the fire. Try it with a file—if the case hardening is properly done the file will not cut it.

Home Made Taps.

Having a full set of dies, it is a simple operation to make all the taps required. Taps and dies play an important part in the repair shop, and if the former are made during dull spells the running expenses of the shop can be reduced considerably. They are made of tool steel rods, Fig. 7 representing an actual size. The rod is first threaded and then tempered. The threaded portion is then ground flat on two opposite sides, about two-thirds of the diameter of the rod being removed. The point is ground on four sides, as shown, to provide easy entrance into the hole. The tap is then tempered.

CHAPTER V.

The Frame.

The accidents possible to a Bicycle frame may be divided into two classes : First, those by which one of the turned oı forged steel parts may be broken at the socket, as shown in Fig. 1, or the crank shaft bracket, as shown in Fig. 2; second the buckling or bending of a tube to such an extent that it cannot be restored to its first strength.

The breaking of either of the parts A B is now an exceedingly rare occurrence. The design, material, and methods of

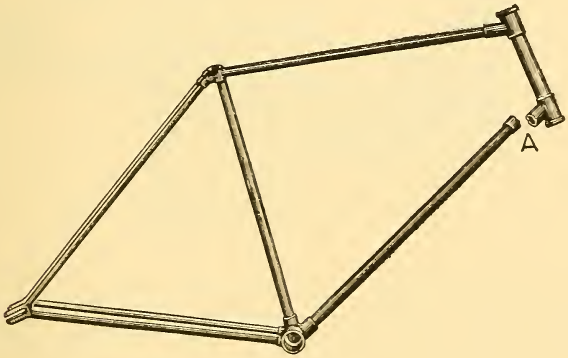


Fig. 1.—Socket Head Broken.

manufacture have been brought to the highest degree of perfection. While the weight has been reduced, seemingly, to the lowest possible limit, the metal has been so distributed as to make these the strongest parts of the Bicycle. This is evidently as it should be, because their integrity is vital to the success of the wheel, and since they are points sustaining the heaviest strains. For these reasons any weakness or flaw in them is bound to make its appearance at the first opportunity

To repair the break shown in Fig. 1 a new socket must be brazed in the upper and lower tubes.

There are no good methods of repairing breaks of this particular character except by providing new parts. Brazing cannot be resorted to, and the introduction of inner tubes and then brazing is delusive, because the surfaces in contact are not large enough to have the requisite strength.

In the making of this frame the tubes enter the socket a short distance, and holes are drilled through both tube and

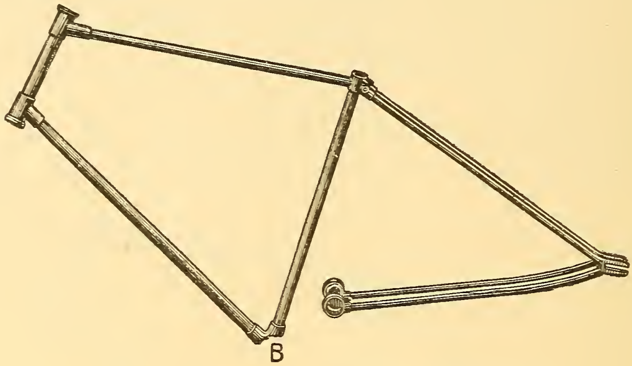


Fig. 2.—Crank Shaft Bracket Broken.

socket to receive pins which hold the parts together while they are being brazed. The enamel is scraped off until the pins are located, when they are drilled out. The joint is then heated in a brazing furnace or large Bunsen burner until the spelter has been melted and the parts can be pulled apart. The tubes are then brazed into a new socket. By careful manipulation of the flame, and by confining and concentrating it as much as possible upon the point to be heated, a single tube can be removed without hurting the other joints.

To place a new bracket in the frame B, Fig. 2, all the tubes are removed from the broken part in the manner just described. They are then pinned in a new bracket and all the joints are brazed at the same heat.

Holding Frame for Brazing.

Although the two photographs from which the drawings, Figs. 3 and 4, were made were taken in a Bicycle manufacturing establishment, and although the devices were designed solely for the making of a Bicycle, their value from a repairing shop point of view is none the less apparent. The first shows a jig designed to hold the tubes forming the front part of the frame while they are being drilled and pinned preparatory to brazing

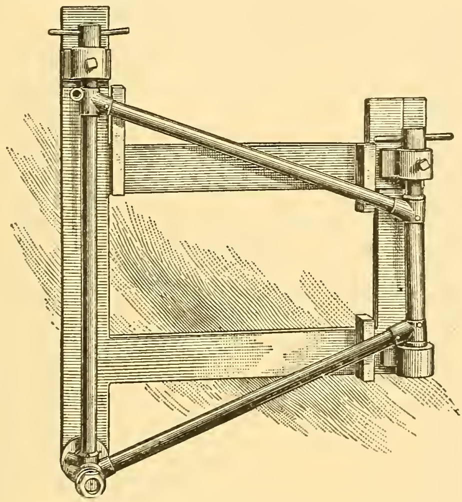


Fig. 3.—Holding Front Part of Frame.

The center bar or tube of the frame is held between centers, as is also the head socket. This method insures the absolutely correct length of the diagonal connecting tubes. While held in this jig the tubes are bored and a pin is inserted in each joint c hold the parts together while they are being brazed. From the jig shown in Fig. 3 the frame passes to the brazing department, where the four joints are brazed.

Upon the completion of this operation the partially made frame is placed in the jig shown in Fig. 4. This, as will be seen by consulting the engraving, holds the front head and center tube of the frame and also gauges the two forks forming the rear of the frame, and holds the entire structure in line while the rear parts are being drilled and pinned together. The flexible shaft drill for doing this work is shown in the engraving. After this the completed frame is taken to the brazing department and the remaining joints united.

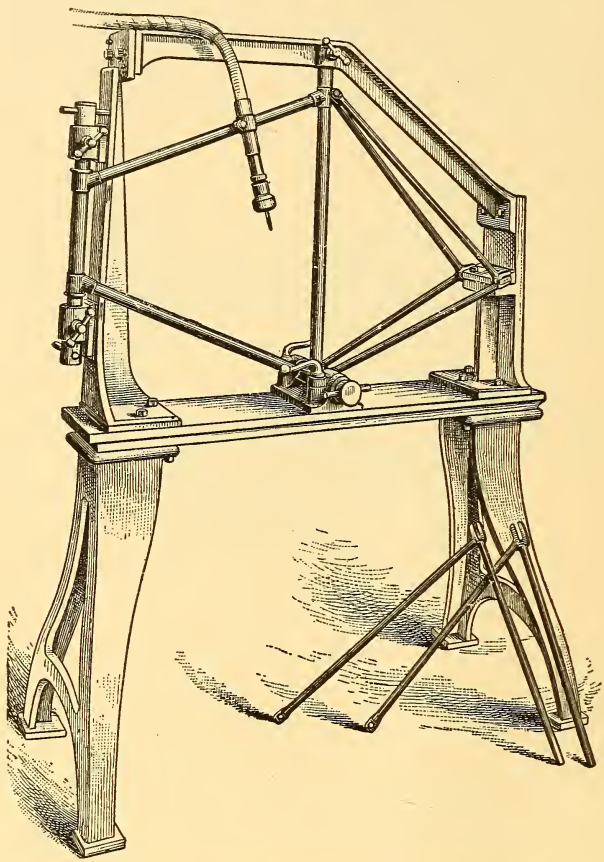


Fig. 4.—Holding Frame Complete.

It is very evident that this device is designed for use only in the large works of a Bicycle builder. At the same time these jigs can be adapted for use in the repairing shop. If the repairer is handling as a specialty only one wheel he can make jigs of this description of hard wood, which will aid him most materially in inserting or replacing any one of the tubes of a frame. Having a guide of this character to hold the frame while he is adjusting the new tube precludes the possibility of the frame being out of true when he has finished the job. On the face, such appliances as these might not seem to be desirable or expedient, but where a repairing plant is designed for quick and accurate work their usefulness is soon felt.

Restoring a Bent Frame.

Figs. 5 and 6 show a simple method of bringing the bent frame of a lady's Bicycle back to its true form. The frame, which originally looked like Fig. 5 appeared as in Fig. 6. First

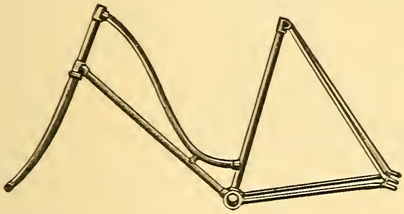


Fig. 5.

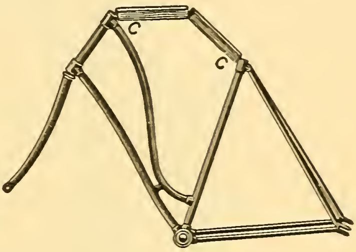


Fig. 6.

Restoring a Bent Frame.

two pieces, C, were sawed the same length, and long enough when placed together to go in the frame between the head connection and seat pillar connection, as per sketch, Fig. 6. By pressing these down straight the frame was sprung a trifle in the proper direction, then, by putting in a small block between the ends of the first boards and thicker blocks after each operation, a very good result was obtained in a few moments. This same method was made use of afterward in numerous cases without any buckled tubes or cracked enamel.

Rack for Holding Frames.

In a large shop, where much work is carried on, the rack for holding frames, shown in Fig. 7, will be found very convenient. Two A-shaped frames are united by top and bottom bars, as indicated. On top of the upper bar are placed short studs of such size as to enter freely the head socket of the frame, the rear portion of which rests upon the projecting base of the rack. A device of this character is of service, as the

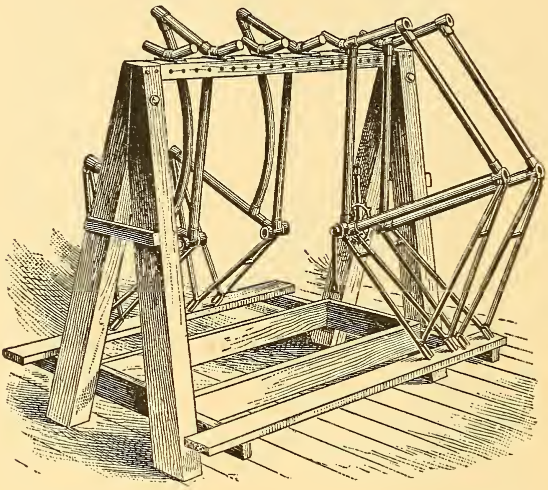


Fig. 7.—Rack for Holding Frames.

frames are held in such a way that it is next to impossible to injure their surfaces. The rack is mounted upon rollers which permit of its being readily moved from place to place.

A Repairing Curiosity.

We cannot commend the repair job shown in Fig. 8, although it possesses one redeeming feature—ample strength. The work was evidently done by a blacksmith who did not care how much he added to the weight of the wheel if he could only make it strong. All of the tubes were broken near the bracket.

A piece of gas pipe was inserted in each tube and the two short straps were put on and their ends secured by rivets passing through the two single tubes. The two circular braces, made of iron about 3-16 inch thick by ½ inch wide, were then placed

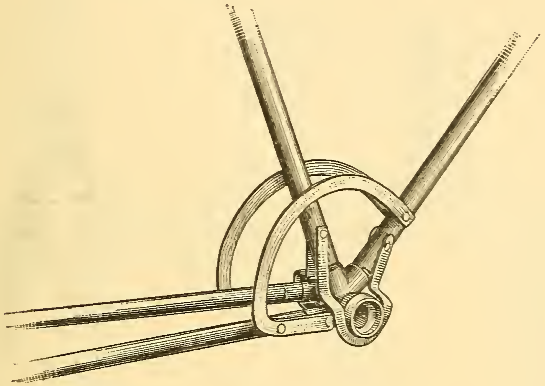


Fig. 8.—A Repairing Curiosity.

and riveted to all the tubes as indicated. No attempt at artistic effect was made, unless we except the curve in the two large braces.

Mending a Broken Tube.

As a general rule it is not advisable to attempt to repair a buckled or broken tube. The best way is to remove the damaged tube and put in a new one. But, owing to circumstances over which the repairer has no control, it may sometimes be necessary to mend a tube which has been broken. The drawings, Figs. 9 to 12, show how this may be done. If the parts have been nicely fitted together and the brazing perfectly performed, the joint will be strong and durable. When the work has been finished, and the tube enameled, there should be no outside indication that a repair at that particular point had ever been made. This job cannot be hurried ; the fitting should be made with the utmost accuracy ; and particular attention should be paid to the brazing.

Figs. 9 and 10 show a repaired head socket and Fig. 12 a repaired center tube which had been broken near the crank bracket. In both cases the method of making the repair is the same, and in all the drawings the same letters refer to like parts. A short section of tube B is fitted in the broken tube C.

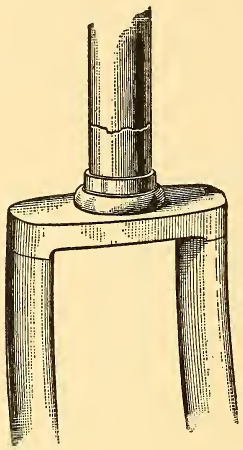


Fig. 9.—Mending a Broken Tube.

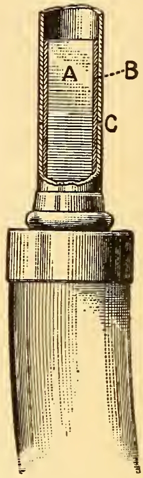


Fig. 10.—Vertical Section at Right Angles to Fig. 9.

Before this section is finally put in place a short piece of flat steel plate A is brazed inside of it. This plate may be ⅛ or 3-16 inch thick, and its side edges should be filed round so as to engage snugly the wall of the tube. The tube B is then put

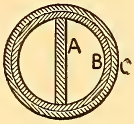


Fig. 11.—Cross Section of Repaired Tube.

in the tube C and the parts brazed. The outside of the joint is then smoothed and enameled.

An important point is the position of the plate A in relation to the tube in which it is inserted. In order to do the most effective service its plane should be so placed that it will the most effectively resist the strains to which the tube may be subjected when the Bicycle is in service. In the case of the head socket the plate should be at right angles to the plane of the fork, as shown in Fig. 10, since the severest strains are in a

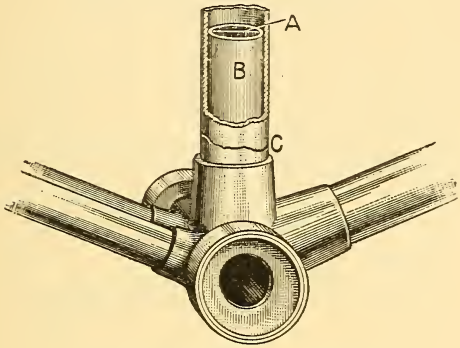


Fig. 12.—Mending a Broken Tube.

line from front to rear of the wheel. For the same reason the plate A in Fig. 12 should be in the plane of the frame considered as a whole.

Straightening a Bent Tube.

A tube that has been bent slightly can be straightened, but a tube that has been bent so that it is buckled cannot be brought to its original lines and it should therefore be replaced with a new one. In a buckled tube the metal at the inner or concave side of the bend has been distorted to such an extent as to most materially lessen its strength, and it may be that it has been fractured at this point. One rule, which may be considered inflexible and which is rigidly followed by all of the leading Bicycle manufacturers is, "never attempt to straighten a buckled tube," because the tube has been weakened and it cannot be relied upon. It may be that there is no flaw apparent to the eye, and yet it can be taken for granted that the usefulness of that tube has been completely destroyed.

A pernicious practice, fortunately not very common, is sometimes followed in the attempt to restore a buckled tube. In this method the bar is heated, then placed across the anvil and struck with a light hammer on the bulging parts of the bend, the endeavor being to restore the tube to its first circular section. If the buckle has not been of too pronounced a character the workman may succeed in maklng a job apparently perfect, but he cannot eliminate the weakness caused by the undue strain to which the metal has been submitted, nor can he overcome the possibly faint hammer marks which will eventually show in the enamel.

A useful tool for straightening a tube which has been bent slightly is shown in Fig. 13. The jaws of this pair of tongs

Fig. 13.—Half Round Tongs.

are formed with semicircular grooves, as indicated. The middle portion of one jaw is recessed to permit the entrance of the other, which is of such a length as to fit in the recess. The tube is placed in these jaws, and by careful manipulation is brought to its original straight condition.

Another and cruder method consists in resting the tube upon two blocks of lead, with the bend uppermost, and then striking the bent part with a lead hammer. The best results are obtained with a comparatively light hammer, the result being more perfect and certain with many light blows than with a few heavy ones, and the danger of producing a deep dent or a distortion in the opposite direction being proportionately lessened.

Device for Straightening Tubing.

In the device for straightening tubing shown in Fig. 14, A is a brass block curved to 1⅜ inch so as to pass under any size of tubing used in Bicycle work, and is made so as to place a strip of leather in it to prevent marring the tube. B B are two slotted brass blocks curved to 1⅜ inch ; leather to be used here also. These blocks are slotted so as to slide on a steel bar, D, that they may be used for either a long or short bend. C is the frame, made of tool steel, and is about 5 inches in length. The

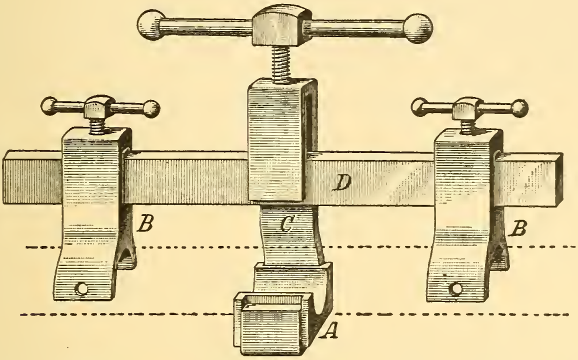


Fig. 14.—Device for Straightening Tubing.

screw placed in the crown presses on the steel bar, raises the block (A) and straightens the tubing.

Truing Up a Frame.

Although, even in the building of a Bicycle, extreme care is exercised in making all the parts accurately to gauge, the

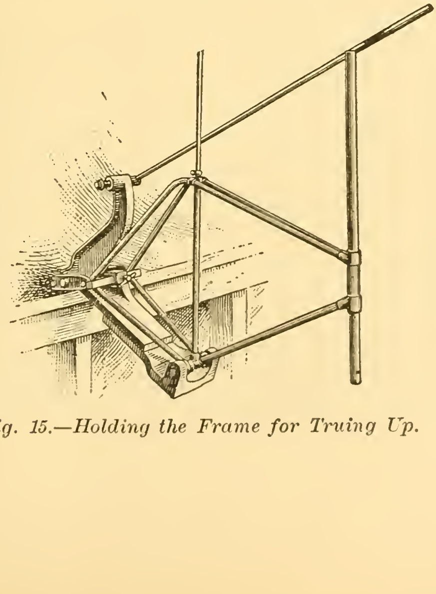


Fig. 15.—Holding the Frame for Truing Up.

frame must be trued up after it has been finished. If the manufacturer finds this necessary, it is certainly essential for the ordinary repairer, who has not the opportunity of using parts made by the thousand and known to be alike. The device shown in Fig. 15 is designed to hold the frame while it is being brought to its correct form. It is secured to the edge of a stout bench, and consists of an upright curved arm, in the upper end of which is a stud carrying one end of a long, straight

Fig. 16.—Gauge for Truing Up Frame.

rod, which is free to be swung up and down in a plane at right angles with the edge of the bench. Hinged to the foot of the curved arm is a second arm, which is formed of two parts fitted to slide upon each other so that the length of this arm can be adjusted to fit the frame to be tested. At the lower end of the second arm are two upwardly projecting lugs, formed with holes to receive the bolt passing through the crank shaft bracket of the frame. The forward end of the frame is secured in the angle of the arms by a cross bar held by a screw, as shown. The frame is thus held rigidly.

To test the frame a bar is inserted in the head socket and another in the diagonal tube. The swinging bar is then brought down, and if it touches both the upright bars their whole length it is known that the head is in line with the center tube, and that both are in line with the center of the rear end of the frame. If the swinging bar, being placed as shown in the drawing, touches only the bar in the head, then a lever is so placed in the frame that the head may be moved forward, or toward the reader. In short, the frame is bent in the direction required to bring the two bars in the same plane.

The next engraving, Fig. 16, shows a gauge inserted in the rear end of the frame. This gauge is T-shaped, the head of the T occupying the place of the axle of the wheel. The stem of the gauge is formed of a bar upon which slides a tube having a short pin extending across it at the center. The two side bars of the frame are bent until the distances between them and the ends of the cross pin are equal. The gauge is then swung over, and the operation repeated between the other two side bars. These two operations insure the proper alignment of the several parts of the frame with the center of the rear wheel.

Truing a Frame witha Straight Edge.

Another method of truing a frame is shown in Fig. 17. A bar, A, is placed in the head socket and this is lined, by the

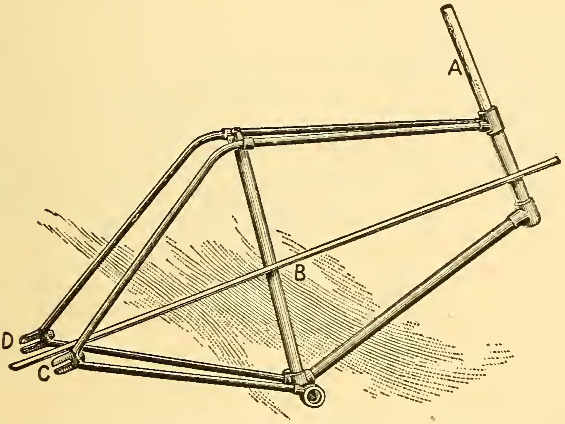


Fig. 17.—Truing a Frame with a Straight Edge.

eye, with the center tube. The frame is sprung as required until the two correspond. The object attained by introducing the bar is the practical lengthening of the socket, thereby obtaining a longer line over which to sight.

To find whether the socket and center tube lie in the same plane as the center of the rear end of the frame the straight edge B is employed. This is held against one side of the socket and center bar, and the distance from it to C measured. It is then held against the opposite side and the distance to D measured. The frame is bent until these measurements coincide.

Truing a Frame with a Cord.

The following method, Fig. 18, of truing a frame is very similar to the one just described. Instead of a straight edge a cord is employed. One end is tied to the lower rear end C of the frame; the cord is then passed around the head A and brought back and secured to the opposite rear end D. The distance from the cord to the tube B is then measured on both sides and the frame is bent until they equal each other, as in the former case. This plan has one important advantage as compared with the one using a straight edge—the cord remains in place until the work has been finished, and the measurements can be more quickly taken.

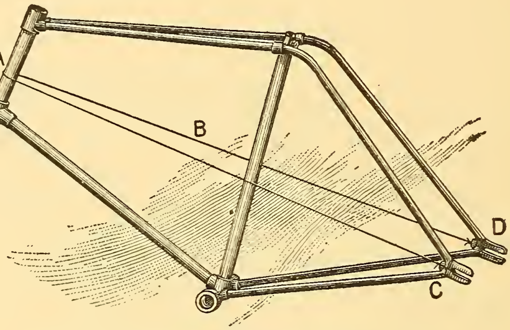


Fig. 18.—Truing a Frame with a Cord.

Truing a Bicycle.

Testing a Bicycle to ascertain if the two wheels tread, or follow each other properly in line, is shown in Fig. 19. The operation is very simple and may be carried on without removing either of the wheels from the frame. The rear wheel is first trued in the way described in previous pages, so that it revolves in a plane midway between the two side bars of the frame. The frame is then to be tested in order to ascertain if the center or seat bar is in line with the head. To find if the two wheels revolve in the same plane, the Bicycle is first placed in a vise which grasps the crank shaft, as shown. Two strings are then held against or tied around the tire of the rear wheel at C and G. The upper string is then passed along the line D E, and is held against the front of the front wheel at F. The other string follows the line H I, and is held against the front wheel at J. There are thus two points of contact of each string with each wheel. It is evident that, the strings being tightly drawn, if they touch both wheels at four points, D E I H, the wheels are perfectly true and in line. If the front wheel forces the upper line out at E so that it does not touch the rear wheel

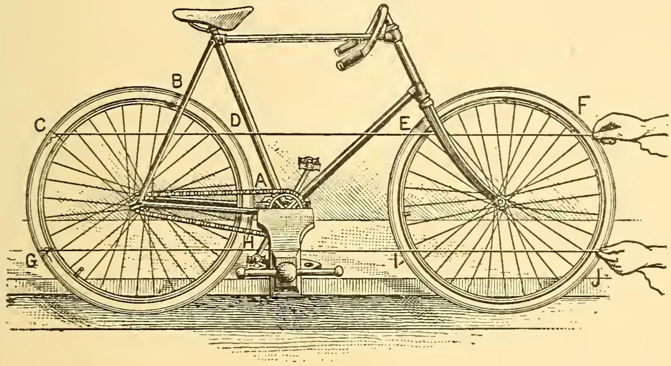


Fig. 19.—Truing a Bicycle.

at D, and if the lower line fails to touch the front wheel at I, then the lower part of the front wheel should be pulled toward the operator. When the reverse is the case and the front wheel pushes the lower line out at I, but does not touch the upper line at E, the bottom of the wheel must be forced away from the operator. By repeating these operations, and frequently testing with the strings, the two wheels may be brought into their true position in relation to each other and to the frame.

Table for Testing a Frame.

The table shown in Fig. 20 is designed for testing any kind of a frame, or, in other words, for ascertaining if all the parts of the frame are perfectly in line, and if not, for finding out which particular part is out of true. The table indicated consists of a perfectly flat or true cast iron top, mounted on suitable legs. At one end (the left hand in the engraving) are two standards designed to hold between them the head socket. Similar standards are placed about in the center of the table for holding the center bar of the frame. Simple gauges are then used for testing. The standards between which the frame is held are formed with holes in their upper parts in which a bar slides freely. The inner ends of these bars are made cone shaped, so as to enter the tubes of the frame.

In making a device of this description the principal consideration is to have the holes in the upper parts of the standards exactly parallel with the surface of the table, and also to have all of the four holes at exactly the same distance above the table. If these requirements are strictly complied with it is evident that the two tubes by which the frame is held in the standards will be exactly parallel with the table, and also that if the frame is true a plane passing through each of the four holes in the standards will divide it exactly in the center. Therefore, by gauging the several parts of the frame, taking the table as a base to work from, any inaccuracy, no matter how slight, will be pointed out. Setting the gauge at each point of each of the tubes will indicate any distortion or irregularity in the tube and also in the frame as a whole.

The gauges resemble, it may be said, in their application, inside and outside calipers. One is shown in position at the rear forks and another midway between the forks and the top of the center tube. These gauges are nothing but blocks of wood, the outside gauge being formed in its upper part with an elongated recess, which is applied to the part of the frame it is intended to measure. The inside gauge is formed with a projection on its upright. In making these gauges the center of the recess of the outside gauge and the center of the projecting part of the inside gauge should be exactly equal in distance from the table, when the gauge is placed in its operating position, to the distance from the center of the holes of the standards to the table. Applying either one of these gauges to any part of the frame and noting the difference in distance between that part of the frame and the top and bottom of the gauge will indicate the direction in which the frame must be pulled in order to bring it true.

Particular attention has been called to this table because it can be made to serve in place of the jig, Fig. 4, page 60, and further than this, by making the standards of ample hight and by arranging one of the center standards so that it can be moved to different positions, the table can be made to accommodate any Bicycle frame on the market. In order to make one of the center standards adjustable, small holes could be bored through the table, and by means of a bolt passing through any particular hole the standard could be placed in any desired position, and could therefore be made to take in a frame of any length, from the head socket to the center tube, and also any length of center tube.

To use the table as a jig for the assembling of an entirely new frame, or for holding an old frame during the insertion of any particular tube required for repair, it would only be neces-

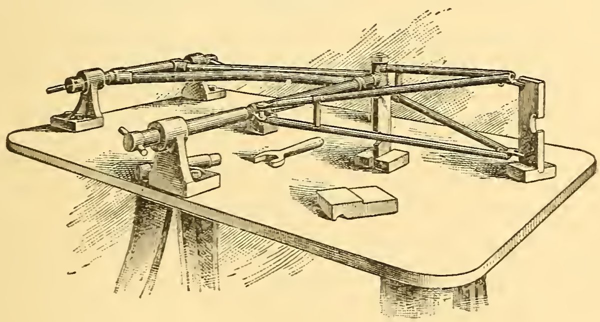


Fig. 20.—Table for Testing a Frame.

sary to adjust the sliding bars in the standards so that they would be in line and so that their conical ends would enter the head socket and center tubes. Then the boring and pinning, preparatory to brazing, could be performed precisely in the same way as in the jigs formerly mentioned, page 59. Where a cast iron top cannot be conveniently obtained a hard wood table, built up of pieces glued together, similar in every respect to the small tables sometimes used on small circular and band saws, could be substituted. This table, in order to insure a perfectly plane surface, should be formed of thin strips glued together in the usual way. Made after this fashion it would serve the same purpose as the iron top and should prove durable and capable of good work.

CHAPTER VI.

The Fork.

To restore a fork which has been distorted by a blow or an unusual strain to its original curve requires more care than in the case of a bent tube of a frame, because the two legs of the fork must be perfectly parallel when the work is finished. If the leg is bent sidewise it can be held in a vise the faces of which are covered with a soft material, or provided with pine

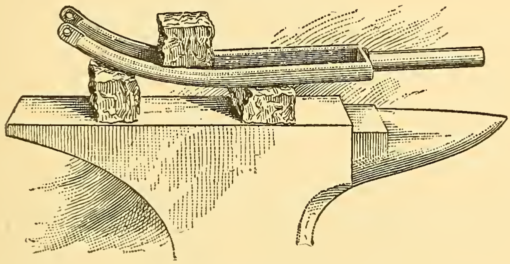


Fig. 1.—Restoring a Fork.

false faces, and then sprung back into place. When the legs are bent in the opposite direction they can be restored by following the plan shown in Fig. 1. This consists of an anvil upon which are placed two blocks of lead upon which the fork is placed, the blows to bring the legs back to their proper form being delivered by a third block of lead or a lead hammer. This method, like every other when a blow is struck upon a tube, must be carefully performed in order not to dent the tube.

Testing a Fork.

A simple way of ascertaining whether the legs of the fork are parallel or not is shown in Fig. 2. The fork is held by the shank in a vise, as shown. A straight edge is then placed near the head of the fork and another across the ends of the legs. By bringing the two edges of the straight edges in line with the eye any irregularity will be made perfectly plain and can be remedied by hammering, as just mentioned, or by springing the legs in the direction in which they should lie.

Although the legs of the fork may be parallel with each other, the shank may not be in a central line between them. To

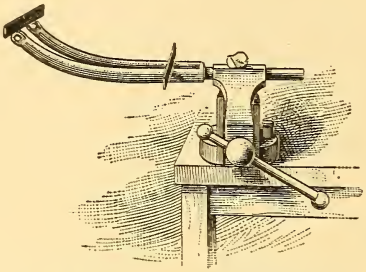


Fig. 2.—Testing a Fork.

test this a straight edge is held against one side of the shank and the distance from its edge to the end of the leg upon that side measured. The straight edge is then placed against the opposite side of the shank and the distance to the end of the other leg measured. If these two measurements are alike the fork may be considered as true in every respect. If they are

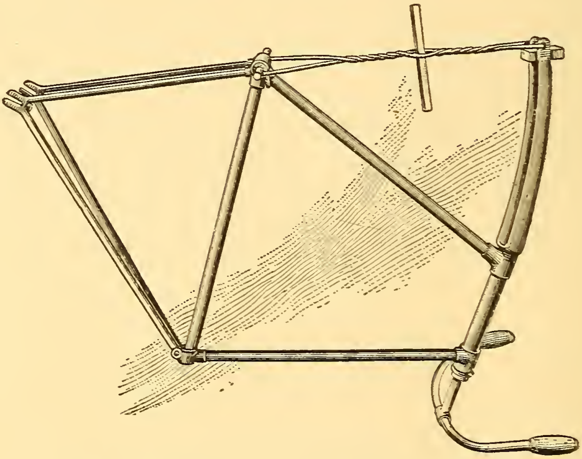


Fig. 3.—Pulling a Bent Fork Into Position.

not the shank is held in the vise and the fork sprung in the direction required until they are. Finally, and as a further check, the wheel should be placed in the fork and the distance from the rim to the sides measured.

Pulling a Bent Fork into Position.

Pulling a fork, the legs of which had been bent near the shank, back to their normal position, is shown in Fig. 3. The fork was first reversed in the frame, since the bend was toward the rear, and it was consequently necessary to apply the force in the opposite direction. A block of wood was then fitted between the ends of the legs to prevent their being brought to-

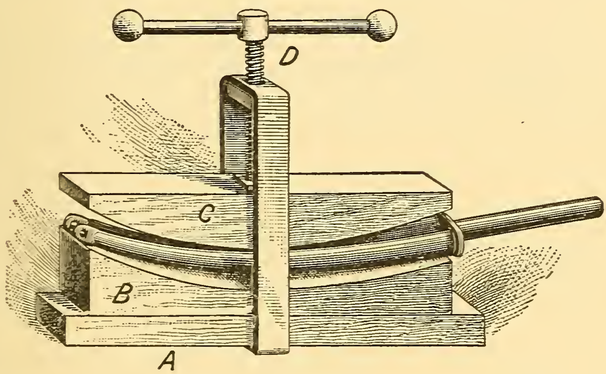


Fig. 4.—Bending Forks.

gether. A rope was then passed through the holes in the fork, carried around the hub and the ends tied together. The rope was finally twisted by means of the stick, as shown. In this way the fork was brought back easily and quickly. While a tremendous strain may be brought upon the frame, there is but little danger of injuring it if the work be judiciously done.

Bending Forks.

A method of bending tubes, and one that is applicable particularly to the restoring of deformed forks, is illustrated in Fig. 4. This plan obviates all danger of denting the fork incident to the use of a hammer or by the methods formerly described of striking with lead blocks. It depends solely upon pressure, which, by means of a screw, can be regulated so as to fit existing conditions. Resting on a base, A, is a block of wood, B, the upper surface of which is inwardly curved. The upper block C is also of wood and is outwardly curved as represented. An iron yoke extends upward from the base, and is provided in its top cross piece with a threaded hole to receive the screw D, which is operated by the handle bar. The blocks C and B will have to be cut according to the curvature desired. In every case the curve of the upper block should be made on a radius shorter than that of the lower one. On account of the elasticity of steel, whether a fork or a plain piece of tube is to be operated upon, it is essential that the curvature of the lower block should be so sharp, or of so short a radius, as to bend the tube more than to the curvature it is desired it should permanently assume. This will be understood from the fact that it is necessary to give the tube a permanent set, and that this set should occur at the point of proper curvature. In order to do this it is requisite to bend the tube a little further than the curvature desired. It is apparent that it is not really important to have two blocks for every different curve desired. By properly packing the outer parts of the surface of the lower curve and the center of the upper curve it may be possible to produce almost any curve desired.

It is evident that this method can be modified considerably and that a vise can be arranged to do the work of the yoke and screw. The two curved blocks B and C can be fitted to the jaws of the vise and the pressure required obtained in the usual way.

Restoring a Twisted Fork.

A twisted or bent fork may be restored in the following way: A piece of hard wood, 2 x 10 inches and 34 inches long, is trued up on all sides. Lengthwise through the middle a distinct line is to be drawn, L, Fig. 5, with a scratch awl and well marked with ink or paint. A square with scale, S, and a separate steel scale, T, Figs. 6 and 7, are also required. Bore a hole in the testing board to hang it up by when not in use.

Now, to remedy the bent fork remove the front wheel, then the handle bar from its socket in the front fork shaft, and if the head cone is not accurately adjusted, do so. Revolve the front fork in its bearings, and if the shank is sprung the manner in which the bearings work will let you form an idea as to the extent of the bend in the shank. Remove the front fork and lay upon the center line of the board, as in Figs. 6 and 7,

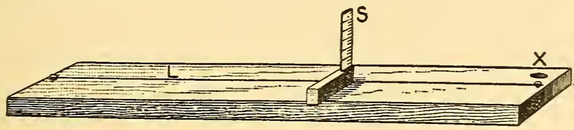


Fig. 5.

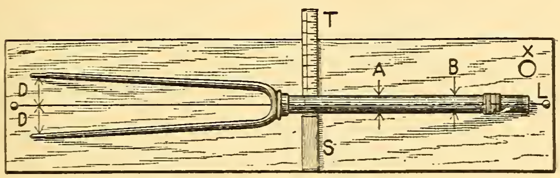


Fig. 6.

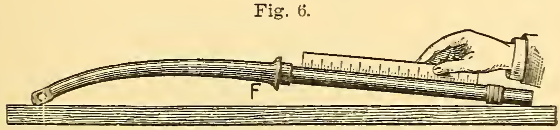


Fig. 7.

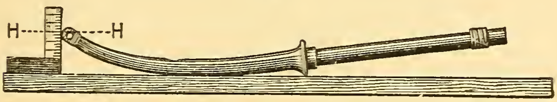


Fig. 8.

Restoring a Twisted Fork.

carefully providing for the same measurement of either half at D and D, Fig. 6.

Now, by placing the square S, Fig. 6, all along the fork shank, as indicated by points A and B, alternately on both sides, and by measuring the distance from the lower end of the blade of the square to the center of the line L, even a very small variation of the shank from a straight line corresponding with L can be detected. The scale should read alike in all measurements opposite to each other along the shank. Any bend in the shank in a horizontal plane can be detected by using the steel scale, as indicated in Fig. 7. If the curve of both fork sides is alike then the scale on the square should read alike with the fork in position, as shown in Fig. 8, and at a point in line H H with the center of the eyes in the fork ends. To straighten the shank procure a block of wood, place it under the fork crown at F, Fig. 7, and interposing another smaller block strike the shank wherever required along the upper surface where the scale rests in Fig. 7. If to be bent in the other direction, as in Fig. 8, only a block to receive direct blows is required, as the fork is already supported at the crown. Should the shank not lay properly on the line L when placed upon the board, as in Fig. 6, it must be straightened on a large block of wood held in one hand by the fork sides and the blows administered with a rawhide mallet. The fork sides at their ends should not be spread any more than is required to just accommodate the hub, with axle and cones, and make a good fit.

See that the two inner faces of the fork ends lie parallel to each other and at an angle of 90 degrees to the surface of the test board when the fork is in position, Fig. 8. These last conditions can be verified by the square, placed on the test board in different positions.

If the fork sides require more or less bend these conditions can be brought about by rigidly clamping the shank in a vise lined with a set of stout hard wood jaws, J, as illustrated in Fig. 9, and by applying a suitable lever, L, resting against one side of the fork crown and against a block of wood near the end of the fork sides, as shown in the engraving. In bending the fork in the opposite direction the lever will be applied in the reversed sense, but in place of the block a steel rod of proper size will have to be passed through the eyes of both the fork ends for the lever to rest upon. For this style of bend manipulations will perhaps be easier if the shank is clamped into the bore H of the wooden jaws.

The upright position was selected as being easier of illustration. It will be understood that the shank is let into the jaws and one or more holes can be bored into them where they join, to accommodate different sizes of tubing. If expense is no object, the jaws can be cast of brass, to wooden pattern, and a

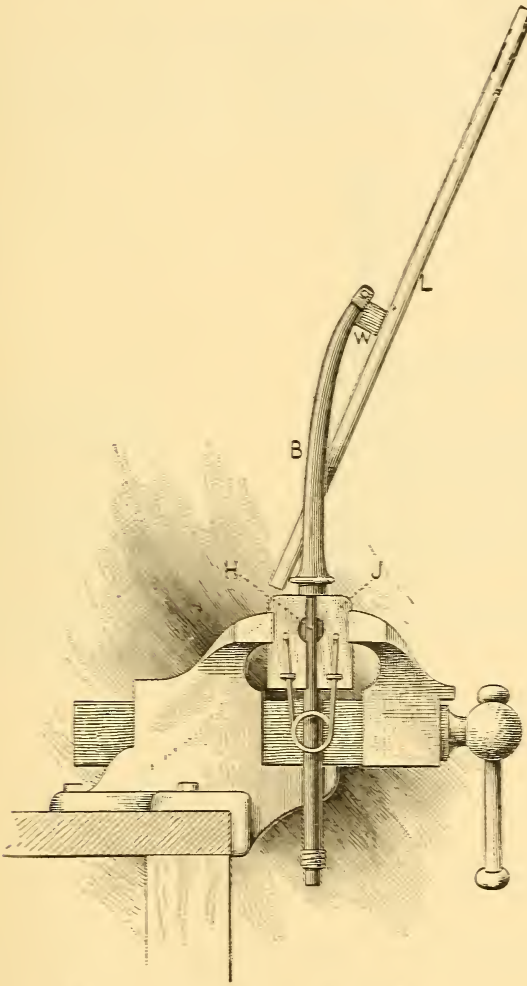


Fig. 9.—Holding Fork in Vise for Bending.

spring on either side of the jaws secures them against accidental displacement when the vise is opened. A moderately short bend is readily brought back to the proper shape by clamping the fork side horizontally between copper jaws and using the shank as a lever.

Forks Bent Unevenly.

A rider runs into an obstruction with his front wheel and bends back the forks, one being bent back a trifle more than

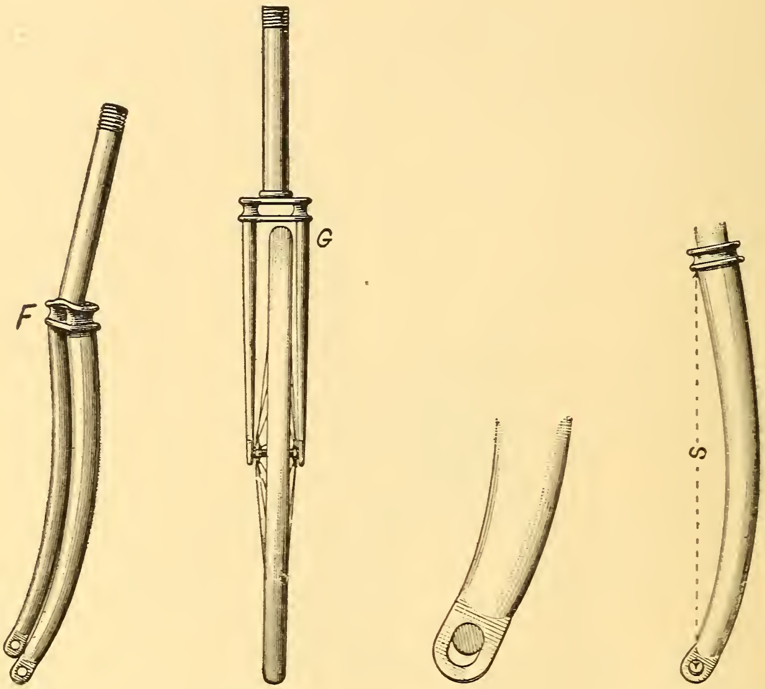


Fig. 10. Fig. 11. Fig. 12. Fig. 13.

Forks Bent Unevenly.

the other, F in Fig. 10. After bringing both forks forward so they are apparently straight, and lining them up in the usual way so the axle is parallel with the fork crown, the wheel is put in, and it is noticed that the wheel does not center in the fork, but is one sided, as at G in Fig. 11. This has been very poorly repaired by filing the hole up higher in the lower part of the fork, where the axle goes in, as in Fig. 12, which will only allow the axle to loosen easily after having been adjusted, and is not a thorough and permanent repair.

On close examination of the above fork it will be noticed that the curve of the two is not alike, and the one that has the least curve is the one that has the tire too close to it, and is generally the damaged fork. This difference should have been made more prominent in the drawing.

The correct way to center the wheel in this pair of forks is to bend this damaged fork back to its original curve, or as near as possible to it, until the wheel centers itself, as by bending

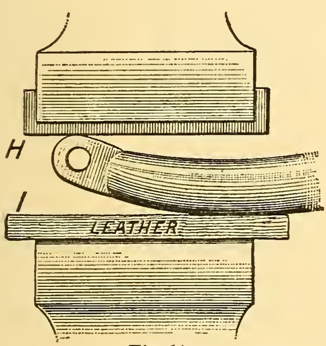


Fig. 14.

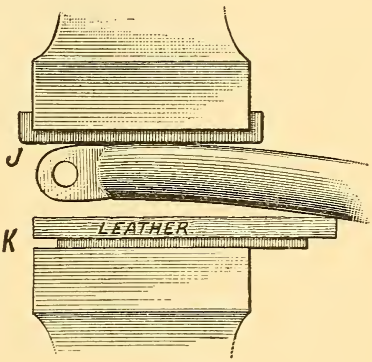


Fig. 15.

Bending a Fork in a Vise.

the curve shorter again it shortens the distance between the axle and crown, as in Fig. 13, at S, and throws the wheel tire further away from the fork side.

This should be done after the forks are lined up sideways, and before they are more than approximately lined up longitudinally, otherwise it would throw them out of line again in that direction. This may be done in the vise by using jaws as follows, and not injure the enamel.

Bending a Fork in a Vise.

For a backward bend a copper jaw at H and leather at I, as in Fig. 14; for a forward bend by a copper jaw at J, and both copper and leather jaw at K, as in Fig. 15, the leather jaw being next to the enameled surface, otherwise the fork will cut through and injure itself upon the sharp corner of the vise jaw.

Mending a Broken Fork.

In the fork illustrated in Figs. 16 and 17 both prongs were broken off through the holes, as indicated by the broken line A B. With a hack saw the ends were cut off about on the line C D, making the cut at right angles to the curved center line of the fork. Then two pieces of steel about 4 inches long and

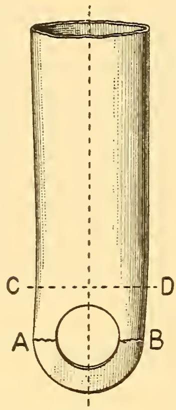


Fig 16.

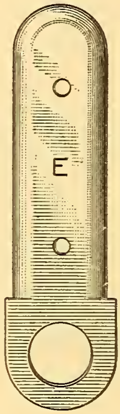


Fig. 17.

Mending a Broken Fork.

⅛ inch thick, Fig. 17, were procured. With a breast drill holes were bored for the wheel axle, and from the shoulders for the shortened ends of the fork, the pieces were filed to the size and shape of the inside of the prongs, the ends of the pieces being rounded, as shown, to guide them in straight.

These pieces were driven in tight, care being taken not to have them so tight as to unduly strain the metal of the fork, then putting the wheel in place to see that the axle holes were placed exactly right. Two rivet holes were drilled through each prong and slightly countersunk on each side of the prongs, and tapped. The rivets were then screwed in and finished flush on each side. A little enamel completed the job, and no one would ever notice the repair unless attention was called to it, and it proved entirely satisfactory after a season of hard service.

Gauge for Truing a Fork.

A very simple gauge of great use in truing a fork or in boring the holes in the ends of the legs, if one or both legs have

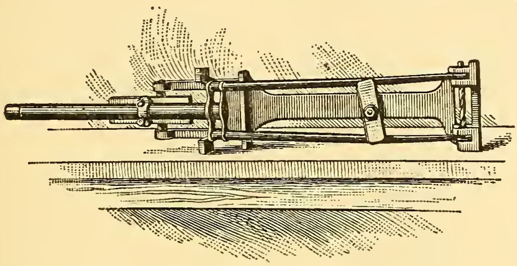


Fig. 18.—Gauge for Truing a Fork.

been renewed, is shown in Fig. 18. The shank of the fork is clamped in a V-shaped groove at one end of the gauge The ends of the fork enter slots in the opposite end of the gauge. The fork is held securely by a clamp at about its center. Held in this way the ends of the fork may be drilled, as shown in the engraving, the drill passing through hardened bushings. The center line of the holes must be at right angles with the center of the fork.

CHAPTER VII.

The Wheel.

The device shown in Fig. 1 is intended for holding the wheel while the spoke nipples are being tightened up and the spokes brought under tension. While such a device is peculiarly applicable to the needs of the manufacturer it would be found to be of great service in the ordinary repair shop, as it is

Fig. 1.—Assembling a Wheel.

so simple in construction and as it is so conveniently operated. It is not intended, with the use of this machine, to bring all of the spokes to their final perfect condition of strain.

The hub of the wheel is placed over a rod projecting from the center of the revolving table and the rim is laid on the frame, about in the position it will occupy when all the spokes are in place. The wheel is then "strung up" as it is termed, each spoke being placed in its correct position. The operator then screws up all the nipples, one after another, and without gauging gets the wheel as nearly true as possible.

The apparatus itself consists of the table mounted upon a spindle, about which it is free to revolve, it being considered better to turn the entire table, and so bring nipple after nipple within reach, than to turn the wheel itself, particularly when the spokes are all loose.

This is another one of those devices upon which a good many dollars could be expended and much time taken in constructing it, while at the same time an equally efficient one could be built in half a day and with an expenditure of only a few cents., Little devices like this, which can be made by the Bicycle repairer himself at odd times, are in a great many cases of much more real value than the same thing would be if made to order and by an expert.

Frame for Stringing Up a Wheel.

A frame for holding the rim of a wheel while the spokes are being inserted and tightened is shown in Fig. 2. The frame is so formed as to be carried by a Bicycle stand, and is shown in its working position in the engraving on page 29. It is a more elaborate affair than the one just described, and is designed to bring the wheel much nearer its true form. It consists first of a yoke or oblong shaped frame carrying a flat cast iron ring, as indicated. Projecting in the same line from the side bars of the frame are two adjustable centers, A and B, the inner ends of which are cone shaped, so as to enter and hold the hub. These two centers may be placed at any distance apart in order to hold a wide or narrow hub, and by means of set screws passing through their sleeves may be held in any required position. The frame carries in a plane perpendicular to its own plane a flat cast iron ring 23 inches inside diameter and 32 inches outside. One face of this ring is turned perfectly flat and is in line with the center of the carrying frame. Concentric circles ¼ inch apart are marked on the surface of this ring. At four equidistant points on the face of the ring are the adjustable stops C, which consist merely of slotted pieces of iron held in place by set screws.

In stringing up the wheel the hub is first placed between the centers A and B. The stops C are then adjusted so as to hold the rim firmly and at the same time in a position concentric with the hub, after which the spokes are inserted and screwed up in the usual way. It will be observed from the dimensions given that this device permits of the handling of all

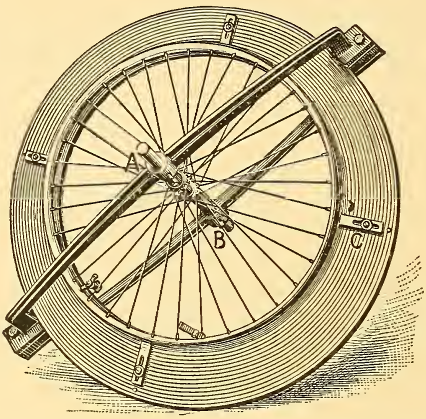


Fig. 2.—Frame for Stringing up a Wheel.

the ordinary sizes of rims, and since the rim and its hub are held in their true positions the spokes can be so tightened that the final adjustment and actual truing up of the wheel will occupy but little time.

Truing a Wheel.

Two methods are shown in Figs. 3 and 4 of truing up the front and rear wheels of a Bicycle. In the first engraving the wheel is shown mounted in its own fork, the same as if for actual service. The shank of the fork is grasped in a vise, which should preferably be of the swivel type in order that the jaws may be brought in a line perpendicular to the edge of the bench, so as to bring the wheel out clear of the bench and thereby permit its free revolution and convenient handling.

The wheel is turned, and a piece of chalk, rested on one of the legs of the fork, is held alongside of the rim so as to touch that part of the wheel projecting toward the side against which the chalk is held. The mark thus made on the rim serves as a guide for the workman, who then loosens or tightens the spokes necessary to bring back the projecting portion of the rim into the true plane of the wheel. As a further precaution the chalk is afterward held against the opposite side of the rim, then resting, of course, upon the other leg of the fork. The advantage possessed by this method is that the wheel is trued in its own fork and that when the work is done the true turning of the wheel, when finally mounted in the frame, is assured.

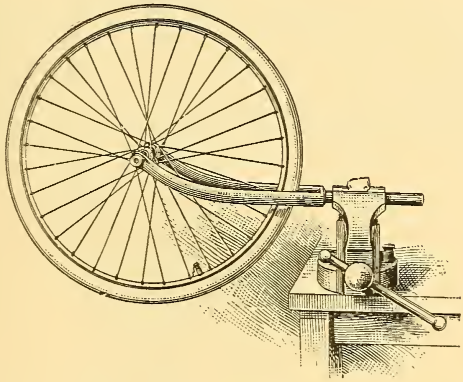


Fig. 3.—Truing Front Wheel Held in its Fork.

In the second method, Fig. 4, the wheel is shown removed from the frame and held so that it may be revolved upon its own axle. At the end of the bench is an upright flat bar of iron, about 1½ inches in width and about 3-16-inch in thickness, provided at suitable intervals with a row of holes to receive the end of the axle, which is passed through either one of these holes and held in position by its own nut. The wheel is then turned and the spokes tightened or loosened in the way described above, the hand holding the chalk being rested upon the edge of the bench.

In this, as in every other operation wherein the spokes are changed in any way, it is of the utmost importance when finally truing the wheel to make each spoke bear its proportion of the load to be carried. In other words, it is essential that each individual spoke should be subjected to precisely the same tension as each and every one of its neighbors. A single loose spoke will, of course, throw additional strain upon those adjoining, the result being what may be called a warping of the

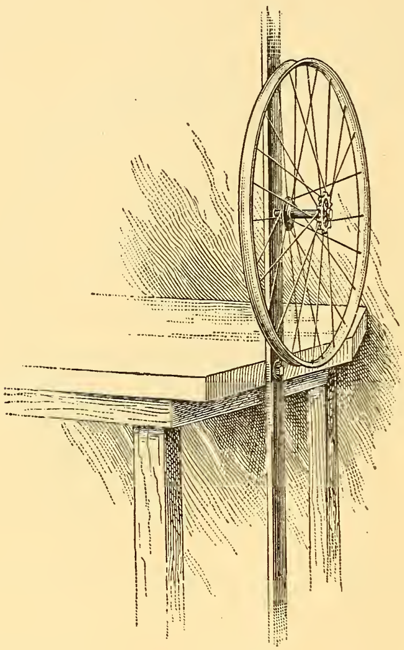


Fig. 4.—Truing a Rear Wheel.

wheel, and perhaps the rupture of some of the spokes. Although this may perhaps be carrying the illustration a little far, the principle is there, that one loose spoke is at least risky, and that a wheel in which the spokes are not under the same strain will very soon meet with disaster. The only way of testing the tension to which the several spokes are subjected is by grasping adjoining spokes in the hand and by the "feel" ascertaining if the pairs are under the same strain. This requires care and a little experience, although at the first attempt the novice will be surprised how surely and quickly he can find out where any difference exists.

Device for Truing a Wheel.

The device shown in Figs. 5 and 6 consists of a hard wood board 1 inch thick, 12 inches wide and 41 inches long. In the center is an opening of the shape indicated. The opening is started 3 inches from the end B, and is 30 inches from D to C and 2 inches wide from L to M. From D to J is 6 inches and the distance across the center of the curved portion, E to F, is 8

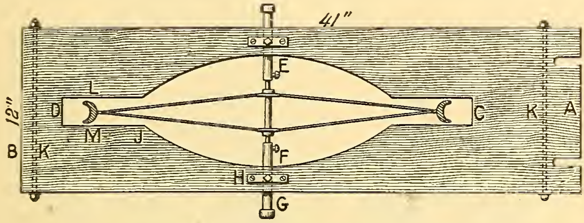


Fig. 5.—Device for Truing a Wheel.

Fig. 6.—The Cone.

inches. The two gas pipes G are ⅜ inch in diameter by 5 inches long and their outer ends are capped. They are inserted in holes in the edges of the board, as shown in the drawing. The two pieces H are made of half round iron 3 inches long and are screwed to the face of the board in such position that the set screws carried by them will engage with and hold the pipes G in the desired position. A set screw is put in each end of the pipe to hold the ends of the shaft. A small bolt, K, is passed through each end of the board to prevent splitting. Two notches are made in the end A in order that the board may be secured to the bench by lag screws, and thus brought into convenient position for working. If the wheel is removed from its axle it may be held in the board by means of two cones, Fig. 6, one in each of the gas pipes G. These cones are made of ¾ inch iron, formed with a shank to fit in the pipe and having a cone turned upon the opposite end.

Jack for Truing a Wheel.

A simple and convenient jack for holding a wheel for truing is shown in Fig. 7.

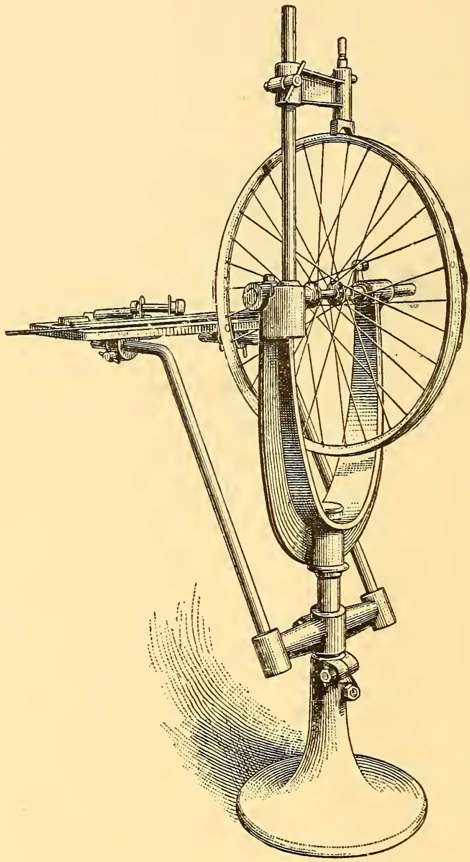


Fig. 7.—Jack for Holding a Wheel for Truing.

Resting upon the top of the base is a cast iron U-shaped fork, the shank of which enters a hole in the top of the column.

The upper part of the device can be turned to any desired position and held in place by the clamp nut shown at the top of the base. Bracket arms extend upward from a cross piece carried by the shank of the fork and hold the table at their upper ends, as shown.

In the top of each branch of the fork is a ball bearing similar in every way to that of the Bicycle. The balls are held in place by an exceedingly thin margin of metal, so that they are perfectly free to operate when the wheel is placed in position. The wheel is thus trued under precisely the same conditions as if held in its own frame. One of the shafts carrying the ball bearings can be moved in or out to admit the entrance and

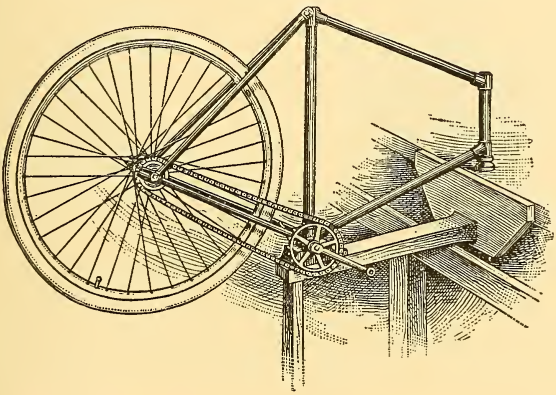


Fig. 8.—Holding a Frame for Truing the Rear Wheel.

removal of the wheel. A nut holds it in place after the wheel has been inserted. An adjustable gauge is held by a standard mounted on one of the branches of the fork, as indicated. The wheel is trued by revolving it and then marking the projecting parts of the rim with chalk in the way already described.

Holding the Frame While Truing the Rear Wheel.

A method of holding the frame on the bench while the rear wheel is being trued is illustrated in Fig. 8. Near the edge of the bench is placed a short stud or bar, projecting 2 or 3 inches above the top, and of such size as to enter freely in the socket head of the frame. A rest projecting from the front of the table and supported at its outward end by a standard reaching the floor serves to hold the middle portion of the frame. By this arrangement the frame is held with sufficient firmness to permit any desired examination to be made and to admit of ready access to all of the parts.

Removing a Broken Radial Spoke.

When the spoke of a radial wheel has been broken so as to leave the threaded part in the hub it is a more or less difficult

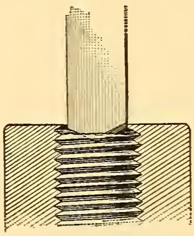


Fig. 9.

Fig. 10.

Removing a Broken Radial Spoke.

job to remove this part. Boring the part out enlarges the hole so that the new spoke must be of larger size than the others and the wheel will present a patched appearance. In almost every instance the threaded part may be removed in the way shown

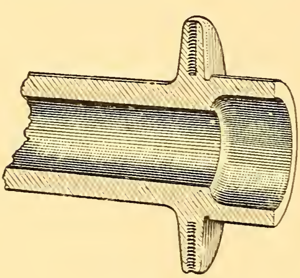


Fig. 11.

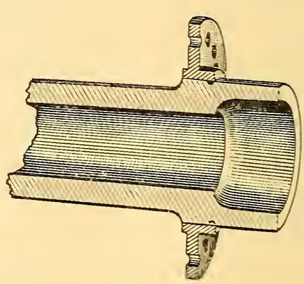


Fig. 12.

Changing a Radial to Tangent Spoke.

in Figs. 9 and 10. These drawings are greatly enlarged in order to make the operation plain. The tool used is a flat drill, Fig. 10, having a very blunt diamond point. The cutting edges, *a a*, are left handed—that is, the drill must be turned to the left when boring with it. The drill is applied to the screw as indicated in Fig. 9. A slight recess is cut in the top of the screw by moving the drill back and forth through a small arc. This raises a ridge in front of the two cutting edges and presents an obstruction to the turning of the drill which is sufficient to permit the screw to be backed out, changing a Radial to Tangent Spoke.

A radial spoke wheel can be changed to a tangent spoke in the following way: The flange of the radial spoke hub shown

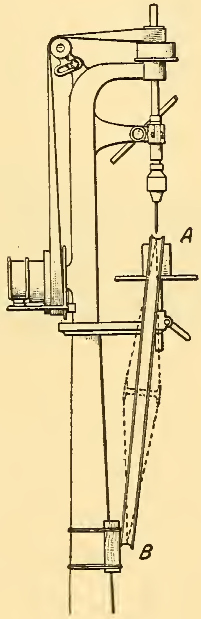


Fig. 13.—Rim Drilling in an Upright Drill.

in Fig. 11 is turned down about even with the face of the hub and a brass disk is formed with a series of peripheral holes and bored to fit the turned down portion of the hub, and is then placed on the hub and brazed in position. The holes in the disk receive the ends of the spokes and the wheel is strung up in the usual way.

Rim Drilling in an Upright Drill.

While drilling a new rim for the reception of the spokes two things should be kept in mind—the holes must be accurately spaced, one from the other, and they must be drilled in line with the hub flanges. The first is essential mainly to preserve the symmetry of the wheel, while the second is important because the spokes should pull in a straight line throughout their entire length. If the holes are not bored in the proper direction the spokes will be bent at the rims, and while this may not be of much account it is not the proper way to do the work. Although the holes can be drilled with a bit and brace and good results attained, a much easier and better job can be done with either an upright drill or a lathe.

Rim drilling with an upright drill is illustrated in Fig. 13.

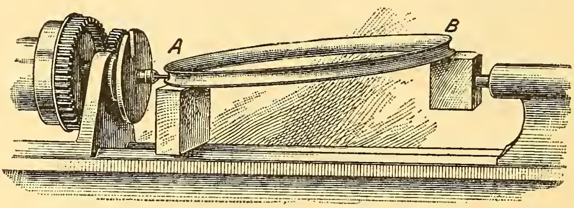


Fig. 14.—Rim Drilling in a Lathe.

On the table of the drill is secured a wooden block, A, having a groove in its upper side to receive and hold the rim in place. Fastened to the drill column at B is a second block of wood, against which the lower part of the rim rests. The plane of the rim is by this means placed at an angle with the axis of the drill spindle, so that the extended axis of the spindle will pass through one of the flanges of the hub. While in this position one-half of the holes are drilled, every alternate hole being skipped. The wheel is then reversed and the remaining holes drilled.

Rim Drilling in a Lathe.

Rim drilling with the aid of a lathe is shown in Fig. 14. Under the drill held in the chuck is placed a block, which is secured to the bed of the lathe. This block, A, is of such hight as to bring the rim central with the drill. In the block B is a hole to receive the tail spindle. This block serves the same purpose as the one fastened to the column of the drill—it throws the rim out of line with the drill a sufficient distance to bring the drill in line with the lower flange on the hub. Every alternate hole is then drilled, after which the rim is turned over and the others drilled.

CHAPTER VIII.

The Tire.

Repairing a Single Tube Tire.

As is well known, the single tube Bicycle tire is formed of alternate layers of more or less pure rubber and strong cloth or canvas. The interior is formed of pure or nearly pure rubber, the object of its introduction being to form an absolutely impervious surface to the passage of air. The strength of this inner layer of rubber is practically nil, its principal office being to fill the interstices found in the material surrounding it and in which the necessary strength to resist the inflation by the air is present. From this it will be readily understood why a tube of this character cannot be effectively repaired by any system of patching placed upon the outside. If the puncture, no matter

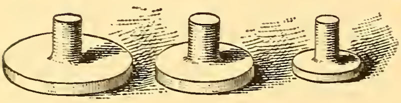


Fig. 1.—Patches.

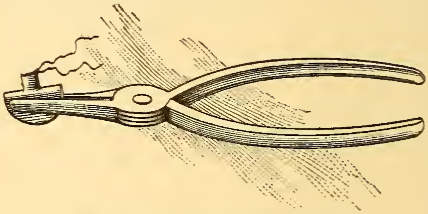


Fig. 2.—Patch Held in Pliers.

how small, extends completely through the fabric of the tube the patch placed upon the outside will merely serve as a bar to prevent the escape of air at that one point. Suppose this to be done, and the hole at this point to be perfectly sealed, then upon filling the tire the air will find its way between the layers and gradually make for itself another opening. Compared with the inner coating of pure rubber all the rest of the tire may be considered as being porous to a certain extent. For this reason if a hole is made in the inner case the air is only partially obstructed in its effort to find an exit, and any remedy applied to the outside will be useful only for a short time. But if a patch can be made to cover the hole on the inside, and if the work be perfectly done, the tire is to all intents and purposes as serviceable as it was before injury.

It is sometimes difficult to locate an extremely small puncture, which, when the substance making the puncture has been removed, may be closed by the elasticity of the material so as to render it invisible to the naked eye. One of the simplest ways, and one which may be tried almost anywhere, is to wet the part of the tire suspected with soap water and then inflate it. The air escaping from the hole will immediately form a bubble, giving a true indication of the location.

The hole once found can only be repaired by passing some substance through it to the interior of the tube, and then cementing this to the inner surface. Generally the hole is more or less ragged in contour, and it should be made as near round as possible by removing the jagged edges. The best way to do this is by introducing a hot piece of wire of such size as not to unduly enlarge the first hole. This will leave the edges of the hole in a charred condition, but they may be cleaned by the application of a little benzine.

Figs. 1 to 5 show how a patch, such as now common, can be applied, and also the required implements for doing the work. The patches themselves, Fig. 1, are made in a great many sizes, so as to fit in almost any kind of hole. They are, as will be seen, formed of thin disks of rubber, provided at the center with a short stem. Before attempting to introduce a patch it should be rubbed thoroughly with benzine in order to clean it. First a string, as shown in Fig. 2, is tied around the stem of the patch near its end, and then the flat portion of the patch is folded over upon itself away from the stem and grasped between thin-jaw pliers, as shown in Fig. 2. Next the patch is forced through the hole in the tire, as shown in Fig. 3. We should state here, because of the subsequent operation necessary, that the tire should be so placed that the part with the hole in it will be underneath; hanging the wheel upon a hook if the tire is not removed, with the hole down, answers every purpose. Having introduced the patch into the tube, the two ends of the string tied about the stem are pulled until the stem appears at the outside of the tube.

Now comes, perhaps, the most important part of the work, since if it is not thoroughly done the patch is absolutely useless. A syringe, such as is shown in Fig. 4, or a soft metal tube, such as paints are sold in, is filled with rubber cement. The spout of the syringe is then introduced into the hole, and as the plunger is forced down to expel the cement the spout is

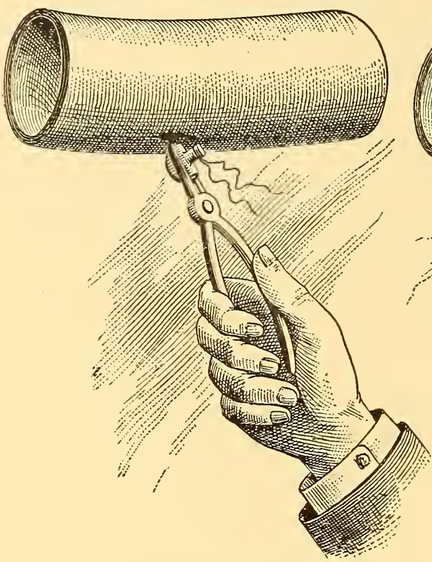


Fig. 3.—Introducing Patch.

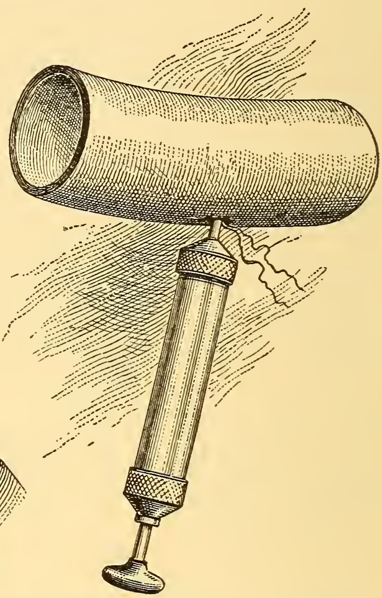


Fig. 4.—Forcing Rubber Cement in Hole.

moved so as to bring the cement, as it issues from it, in contact with every part of the disk of the patch, which is now upon the inside of the tube, and also to thoroughly smear the cement over that portion of the tube adjacent to and surrounding the hole. When the operator feels that this object has been accomplished the syringe is removed and the string pulled to bring the patch close against the inside of the tube. As a final precaution it is well to grasp the projecting stem of the patch in the pliers and thus move it around until it has become thoroughly seated upon that portion of the tube wetted by the cement. The stem is then cut off, leaving the outside surface of the tube smooth and in good condition. It will be apparent that this work could be done in the case of a very ragged hole, but while the patch would perform its duty just as well, the

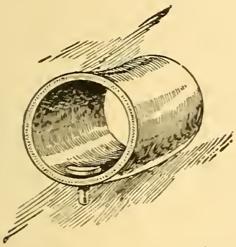


Fig. 5.—Showing Patch in Place.

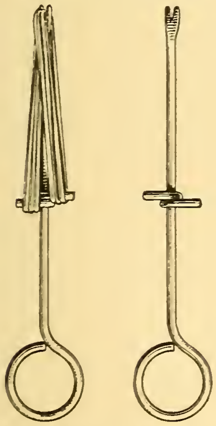


Fig. 6.—Needle for Repairing Tire.

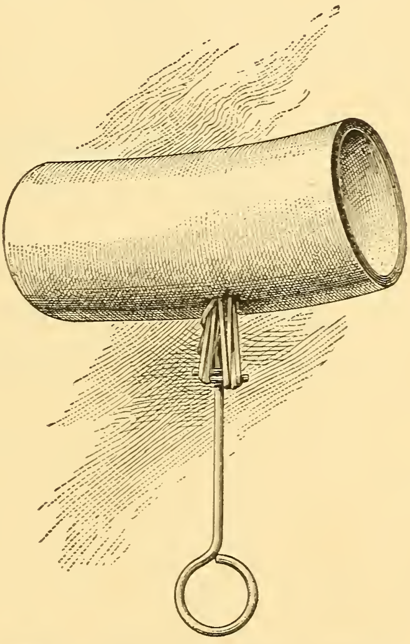


Fig. 7.—Showing Application of Needle with Rubber Bands.

appearance would be against it, as it would be impossible to make the stem fill every portion of the hole.

Just as soon as the patch has been seated and the operator thinks that the disk rests snugly upon the inside of the tube, the tube should be inflated. This inside pressure will serve to force the patch down hard against the tube and to hold it in position until the cement has thoroughly set. Finally the repair is tested in the usual way, by placing the inflated tire in water and observing if any bubbles appear at the mended portion.

This method of repairing a puncture may be applied to holes of even quite large sizes, this being done either by the introduction of one large patch or by two or three. If a not too long slit is made in the tire patches can be placed, as described, upon the inside; then the outside edges of the slit should be stitched together in two or three places, and finally, and before fully inflating the tire, an outside patch of strong rubber cloth should be put on. As explained above, this outside patch is of but little use in preventing the escape of air, but where the slit is made it would be necessary to re-enforce the tire at that point by a strong material in order that the strength would be sufficient to confine the air. Although manufacturers of rubber tubing have no difficulty in making any repairs, even to the taking out of a complete section of the tube and inserting a new one so nicely that the joint cannot be seen, such work cannot be performed except by an expert. Therefore there are some punctures which cannot be repaired, except very crudely, by any one not having the needed skill and appliances of a special kind.

A very small aperture can be filled by the method shown in Figs. 6 and 7. In the former view is illustrated a needle formed with a fork at the point and a cross bar half way between the fork and the loop of the handle. This needle is then strung with rubber bands, as shown to the left in the engraving. Rubber cement is introduced into the hole and then the rubber bands are smeared with the cement and the needle pushed into the opening, as shown in Fig. 7. After the bands are in place their projecting parts are trimmed off. It is apparent that the number of bands will be controlled by the size of the opening it is intended to fill. This method is what we might term only a makeshift. It is by no means as reliable as introducing a patch, but it will serve the purpose, if need be, for a time.

Patching an Inner Tube.

Repairing an inner tube is a very different operation from that just described, and is one that requires delicate and skillful handling in order to be successful. This tube is made of very pure rubber, and when not distended by air it is not stiff enough to maintain itself as a tube, as the outer tube does. This falling together of the walls of the tube makes it difficult to repair a break because of the danger of cementing the inner surfaces of the tube itself. This risk can be somewhat lessened by the use of soapstone dust introduced through the hole in the tube. Suppose the damage to be caused by a small slit in the tube. The edges of the slit are to be brought together perfectly, the surrounding portion of the tube and the

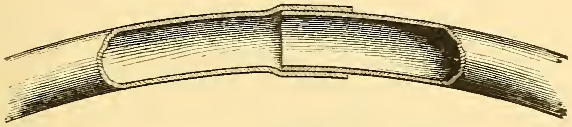


Fig. 8.—Repairing a Large Break in Inner Tube.

patch covered with cement and the patch applied. Enough air should be pumped into the tube to separate the surfaces at the hole. Careful manipulation with the hands will aid in doing this work. As the air continues to be pumped in the patched part of the tube can be grasped in the hand in order to prevent the patch being lifted by the air pressure. A method attended with less danger is to apply the cement around the slit, but not to the edges of the slit itself, and to leave an uncovered portion on the patch a little larger than the slit. By this means there will be small risk of any cement finding its way inside the tube. The patch should be of rubber as pure as that of the tube.

Repairing a Large Break in Inner Tube.

Fig. 8 illustrates a simple and effective way of repairing a large break in the inner tube. The tube is cut in two at the rupture and one part is inserted in the other, as shown in the drawing. Before the parts are put together the surfaces which are to come in contact are first cleaned with benzine and then covered with rubber cement. As the inner tube is elastic to a high degree, the shortening due to the overlapping is of little consequence. By this method of patching a tube there is very little danger of cementing the inner surfaces together.

Preparing an Inner Tube Patch.

Sheet rubber for patching is placed on the market in several different forms. Those in most common use are the sheets of pure gum and sheets of gum backed with canvas. The latter is for patching when it is desirable that the patch itself should contribute to the strength of the tube; the former is employed when it is only necessary that the patch should render the tube

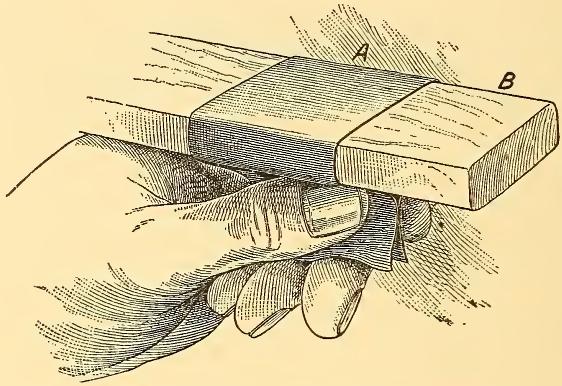


Fig. 9.—Preparing an Inner Tube Patch.

air tight. These are covered with cement before applying, and the surface surrounding the hole is first thoroughly cleaned with benzine and then covered with cement. The cement should be applied five or ten minutes before the patch is put in place. All parts of the patch must be pressed into close contact with the tube, and after the job has been finished the soapstone should be rubbed on.

It will be found that the application of the cement to the pure sheet of rubber will cause it to curl, and there will be more or less difficulty in handling it. This can be remedied by proceeding in the way illustrated in Fig. 9. The rubber sheet A in stretched over the wooden strip B and the cement rubbed on. The rubber is kept taut a minute or two, after which it can be removed from the stick with no fear of its rolling up.

Removing Inner Tube.

Sometimes there is trouble in removing the inner tube, which may be found fastened or cemented to the outer or inclosing tube. This sticking is caused by the fact that when the inner tube was inserted not enough soapstone powder had been placed between it and the outer tube, and therefore the "raw" places on the surface of the inner tube had become cemented to the other. To completely obviate this difficulty it is only necessary to rub the inner tube thoroughly with soapstone dust, paying particular attention to any places where the surface has been cleaned, or places where patches have been applied. If this precaution is not adopted, it is evident that, after the inner tube has been drawn into position and the tire inflated, the great pressure will cause the union of the two tubes at all points where the surfaces have not been protected. The soapstone acts as a barrier between the two and prevents their coming into too close contact A quantity of the soapstone should be placed in the outer tube before the inner one is drawn through ; if this is done the easy removal of the inner tube at any future time is insured.

If the inner tube sticks it may be loosened by pouring a small quantity of benzine or gasoline between it and the outer one and then gently pulling upon it. During this operation the tire should be held in such a position that the benzine will follow the inner tube as it becomes detached from the other. The benzine serves to cut the imperfect union which has taken place between the two tubes, and aids in their ready separation. The inner tube, being such pure gum, will stand considerable pulling without injury.

Lacing a Tire.

A very handy way of placing the tire for lacing is as follows : Suspended from the ceiling over the work bench is a large wire hook and placed in the bench back of the edge is a second one. The tire is placed in the hooks and over the shoulders, the slit resting on the bench in convenient position for lacing.

The lacing should be what is commonly known as the "over stitch." This makes a very neat job, and will not pull the eyelets out of the case or cause a swelling at any part of the slit when the tire is fully inflated. An extra long cord and two needles are required for the work. The best kind of needles to use are sailmakers', which have a broad curved point and large eye.

Cementing Tires to Rim.

For cementing tires to rims the following preparation may be used: Dissolve 2 pounds of shellac in ½ gallon of alcohol.

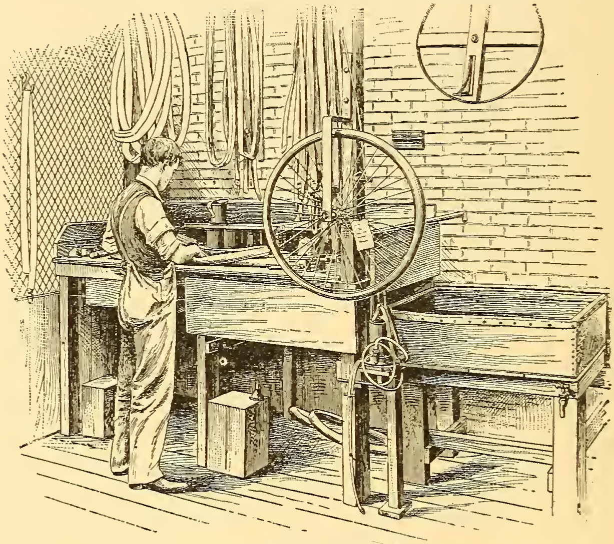


Fig. 10.—Tire Repairing Corner.

With a brush apply two coats to both the tire and rim, allowing the first coat to dry before putting on the second. Put the tire on, pump up hard, and let the cement dry thoroughly before riding.

Another way is to melt common red cement in a ladle, pour it on the rim and let it dry or harden. Then soften with gasoline and put on the tire. A very good method for use on wood rims is to make a cement by dissolving red tire cement, broken in small pieces, in 8 ounces of bisulphide of carbon. This preparation will be of the consistency of cream and must be kept in a tightly corked bottle. Apply with a brush, put on the tire and pump up. This cement is also excellent for fastening cork handles.

A single tube tire that by reason of long use or any other cause has become so full of holes that it cannot be patched, may be renewed for a time by cutting off the valve stem, slitting and punching lace holes and then inserting an inner tube.

Tire Repairing Corner.

The engraving, Fig. 10, shows a corner devoted to tire repairing. At the right hand end of the bench, which is about 40 inches high, is a rack for holding the wheel being repaired. Below this is an air pump, and still further to the right is a tank for testing tires. On the wall are hooks for holding new and old tires. Everything necessary is within easy reach of the workman.

CHAPTER IX.

The Valve.

Repairing Inner Tube Valve Stem.

It frequently happens that the air will leak out around the base of the stem of the valve of an inner tube. Applying patches consisting of strips of sheet rubber to the joint is an unsatisfactory way of doing the work. A more perfect and serviceable job will result if the defective stem is removed and a new one put on. To remove the old stem insert the spout of

Fig. 1.—Repairing Inner Tube Valve Stem.

an oil can filled with benzine under one edge of the flat base of the stem, as shown at B in Fig. 1. The stem can then be pulled little by little away from the tube, the spout following the line of separation. The new stem is then cleaned, cemented and put on the same way as a patch.

Repairing a Single Tube Valve.

It is next to useless to attempt to repair, by any system of patching, a leaky valve stem of a single tube tire. The work will not be permanent, and sooner or later trouble will be found at the same point. Perhaps the best way is to remove the old valve stem, insert an inside patch and plug, and then put a new valve in some other part of the tire. If the lower part of the valve stem is of rubber it is necessary that the union between the base and the inner part of the tube should be perfect. This is of the greatest importance, because, if the inside joint is not true in every part, the air will find its way along the fabric in the center of the tire wall, and thence escape through the comparatively coarse and porous rubber forming the outside covering.

It may be well to state that the perfect insertion of a rubber valve stem having a rubber base in the ordinary hose pipe tire requires skill only to be obtained in a rubber manufactur-

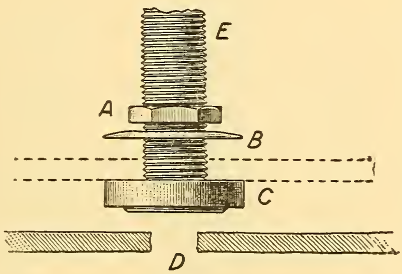


Fig. 2.—Repairing a Single Tube Valve.

ing establishment. The valve referred to is in most respects identical with the valve as originally placed in the tire. Many repairers, when valves of this kind are to be fixed, send the tube back to the manufacturers, or to some concern which makes a specialty of doing work of this kind. In order that the job may be substantial and durable it is essential that the inner part or base of the valve should be in perfect contact with the interior surface of the tire, for reasons before mentioned, and as a final precaution vulcanization is needed. While as a makeshift the base of the valve can be forced through the hole made in the tire and then cemented in a manner similar to that followed in applying a patch, the task is one that is extremely difficult, and one that, moreover, will almost always cause trouble in the near future.

A valve stem possessing several advantages is shown in Fig. 2. An opening, D, is made in the tire. The stem E is threaded and at its lower end is formed with a cap, above which is the rubber washer C. This washer is squeezed through the opening, the tire then occupying the position indicated by the dotted lines. The nut A is then screwed down on the washer B. This device clasps the tire firmly between the two washers B and C, and as the latter is made of rubber there is no danger of cutting the tube.

Repairing the Valve Proper.

The drawings, Figs. 3 and 4, show the interior construction of a valve which is more or less extensively used and which

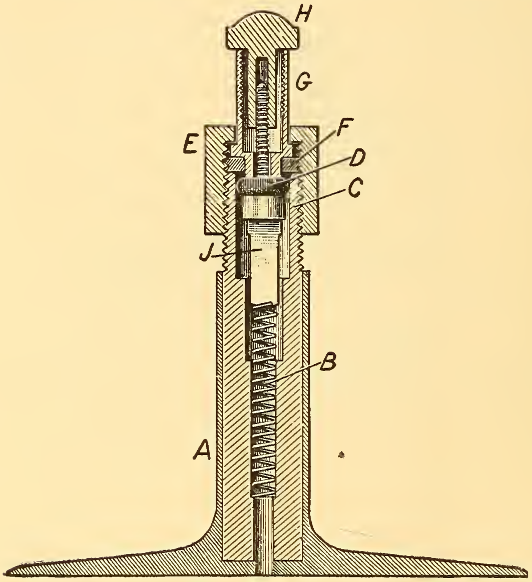


Fig 3.—Repairing the Valve Proper.

possesses many good features. This valve is selected merely to illustrate about how much work, in the shape of repairing, the ordinary repair shop can undertake profitably, and also when it may be desirable to discard the valve entirely and substitute a new one. The first drawing shows the valve in vertical section, all the parts being in their proper positions. In the second drawing the parts are all separated, so that the form of each individual piece can be seen, while at the same time, by means of reference to the letters in the two engravings, which refer to similar parts, the detached portions may be readily located. Projecting from the rubber base of the valve is a rubber stem, A, at the top of which is inserted the threaded brass portion C. For a short distance from the top this brass portion is formed with a circular opening, and at the bottom of this opening is a rectangular extension to receive the flattened lower part of the plug J, which, in reality, constitutes the valve

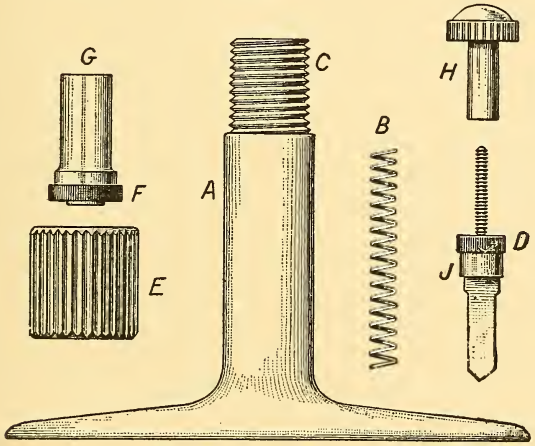


Fig 4.—Repairing the Valve Proper.

proper. The upper part of this plug is threaded to receive the cap H, which surmounts the whole and binds all the parts together. The lower part of the plug is flattened and enters a corresponding recess, merely to prevent its turning when the cap is screwed on or off. The plug J enters the sleeve E, which screws upon the top of the stem A, the part G entering the sleeve E, and when the cap is screwed down the two rubber washers, that on the plug indicated by D and the other at F on bottom of the part G, form the actual seal of the valve. A simple spiral spring, B, which is placed loosely in the bottom of the stem A, acts to lift the plug J during the first stages of inflation, when the air pressure in the tube is very slight. It may happen that this valve will become inoperative after it has been set, so to speak, for several weeks, by reason of the rubber washers, particularly the lower one, having obtained a permanent set. This, of course, can be quickly remedied by the insertion of a new one. If any parts of this valve should become broken or dented, so as to render the device useless, the required repair can be made without much trouble, but, as is evident from the construction, such disaster is of extremely rare occurrence.

In valves having a metal seat in which the two ground surfaces come together, a repair can be made when these seats become roughened so as to permit the escape of air by reason, say, of the entrance of particles of sand, but the work is one which, if done on a lathe, requires skill, and can only be profitably accomplished by fine grinding. Other forms of the valve depending upon rubber or upon metallic contact may be fixed, but in the great majority of cases, unless the repair is an extremely simple one and can be quickly performed, it will not pay to undertake it, because mainly of the cheapness of a new valve. In the majority of cases it would therefore seem more advisable to replace a valve that is out of order by buying a new one rather than attempt to apply any remedy. This particularly holds good for a repairer who is not perfectly familiar with the valve, and if he cannot tell at a glance just exactly what to do and about how long it will take him to do it.

CHAPTER X.

The Handle Bar.

Many riders have notions peculiar to themselves as to the proper shape or form of the handle bar; or it may be that an individual's experience has taught him that with a bar of certain curve he can obtain the best results. It is only necessary to look at the handle bars at any "meet" of wheelmen to be convinced that there is no rule controlling the shape, and also that opinions vary as to the best shape for the purpose, whether racing or ordinary road work.

In order to meet the requirements of the rider it becomes essential to make the handle bars of exactly the curve he favors. It is, of course, important for the rider to give the maker or repairer a correct idea of the curve he wants. This is commonly done by adopting one of the three following courses: To make drawings showing the curve desired, to send a photograph of a handle bar like or nearly like what he requires, or to send a wire bent to the right shape.

The first plan requires the services of a skilled draftsman in order that the ideas may be made plain to the one who is to do the work. There is also much liability to error, either in the first making of the drawings or in their subsequent interpretation by the repairer.

A photograph is preferable, but it is not always convenient to obtain one. A picture can be followed very accurately by the repairer, and it possesses the further advantage that slight changes or modifications in the curves can be verbally indicated by the owner with the conviction that they will be readily understood and correctly followed by the workman.

The third plan is undoubtedly the best, since it is the easiest to make and since its use obviates all possibility of error. Ordinary telegraph wire is stiff enough for the purpose. This is cut the right length, bent as may be desired and handed to the repairer, who, with this guide before him, finds no difficulty in making the handle bar the same shape.

No trouble should be experienced by the repairer in making a handle bar of any shape. Two ways are at his command: One is to fill the handle bar tube with rosin and then bend it cold, after gripping it in a vise between soft pine pieces. The rosin, which is melted and poured into the tube, obviates all danger of buckling. After having been bent the tube is heated to melt the rosin, which is then poured out.

Form for Bending a Handle Bar.

The other plan is to heat the bar in a Bunsen flame to a dull red and then bend over a form, as shown in Fig. 1. This

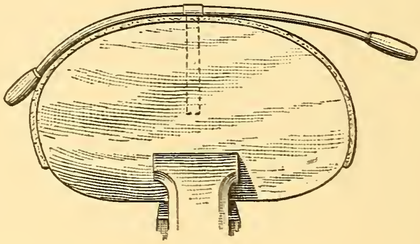


Fig. 1.—Form for Bending a Handle Bar.

form is made of pine, about 1½ inches thick and curved on one edge to conform to the handle bar to be made. This curved edge is then covered with a strip of asbestos to prevent the burning of the wood by the heated bar. In the center of the curved portion of the pattern is bored a hole, as indicated by the dotted lines, to receive the shank of the bar. The bar is heated, 2 or 3 inches at a time, and then bent, step by step, until it coincides with the pattern. The first heat is applied to that part nearest the shank, and from there the alternate heating and bending go on to the end. In this, as in all other instances where it is requisite to bend a tube, extreme care should be exercised not to overheat the metal and not to attempt a too abrupt bend at one heating. Buckling and consequent destruction of the tube may be the result.

Simple Device for Bending Handle Bars.

A handle bar that has been bent out of shape may be restored to its normal lines with the aid of the device represented in Fig. 2. This is a block of very close grained hard wood, measuring 6 x 6 x 8 inches. Through the 6-inch thickness a

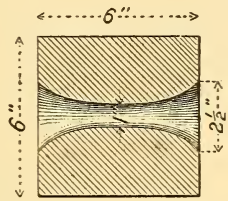


Fig. 2.—Simple Device for Bending Handle Bars.

1-inch hole is bored. This hole is then to be countersunk on both sides to a bell-mouthed shape, with the largest opening of 2½ inch. All sharp lines should be cut and filed perfectly smooth so as to present a cross section, as sketched in Fig. 2.

The manner in which this block is to be employed in bending or correcting the bends of the handle bar is illustrated by

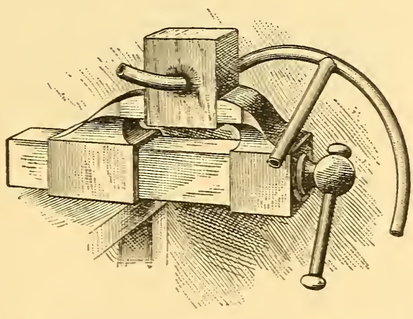


Fig. 3.—Method of Using Block Shown in Fig. 2.

Fig. 3. The tube is passed through the bell-mouthed bore, and, by using the free parts of the bar as a lever held in one's hand and by exercising the proper care and strength, most bent bars can be restored to the original lines.

Machine for Bending Handle Bars.

The apparatus shown in Fig. 4 is much more elaborate. It consists of two large grooved rolls and a smaller grooved roll carried by the lever arm, the smaller roll being intended to travel around one of the larger rolls and thereby bend the pipe, which is placed between them, as will he understood from the engraving. The device is so constructed that it can be adjusted to bend work of different lengths and also to different curves. This is accomplished by having one of the rolls movable in a slot. This adjustment is for different widths of handle

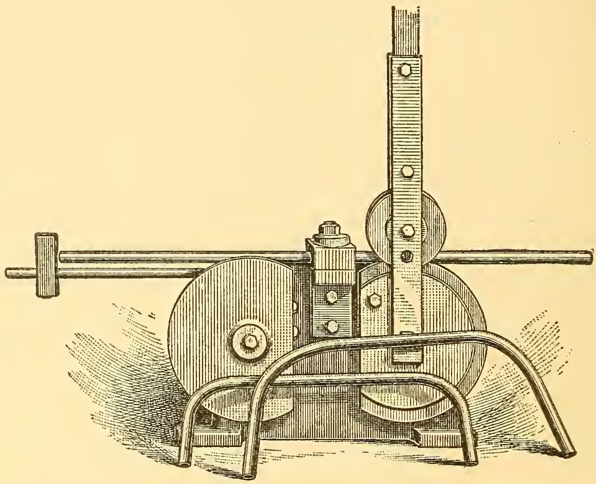


Fig. 4.—Machine for Bending Handle Bars.

bars. For different curves the rolls must be changed to larger or smaller sizes, as may be required. The rolls are designed so that it is possible to obtain a complete circle. The tubing bent on this machine is first filled with rosin.

Removing and Replacing Handles.

In the majority of wheels the handles are made of either one of two materials—hard or vulcanized rubber or cork. Much uniformity also exists in the methods of securing the handles to the handle bars. Generally they are bored to fit snugly on the ends of the bars, and are held in place by a cement which has a low melting point. The ends of the bars are threaded to receive screw caps, which serve the double purpose of ornaments and additional guards for the handles. Cork handles may be removed by holding the bar in a Bunsen flame at a point just above the handle. The heat will then be conveyed by conduction to that portion of the bar within the handle. This will soften the cement so as to permit of the withdrawal of the handle. Hard rubber handles may be removed by immersing them in hot water, this method being adopted in order to make sure that the handle will not be injured by too great heat.

To replace the handles the ends of the bar should be thoroughly cleaned and then heated sufficiently to melt the cement applied to them. The handles can then be worked on by giving them a slight turning movement.

CHAPTER XI.

Miscellaneous Hints.

Removing a Ball Bearing Case.

In some Bicycles the inner half of the bearing for carrying the balls consists of a circular case, *a*, Fig. 1, which has a square outside section, and a curved inner section to receive the balls. Each end of the crank shaft bracket is enlarged to receive the case, which is forced into position by pressure and is held in place by the grip of the surrounding bracke. The center of the flat portion of the case is removed to permit the passage of

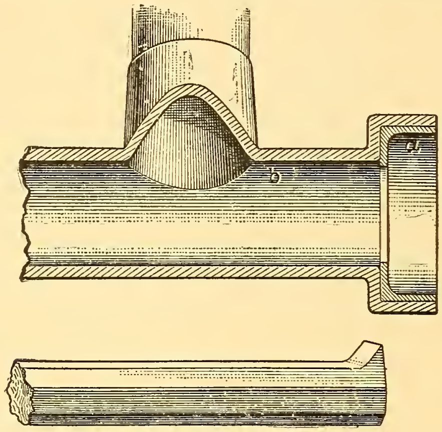


Fig. 1.—Removing a Ball Bearing Case.

the axle, but the hole so formed is not as large as the bore of the bracket. A small ring of the case projects into the opening. To remove the case, *a*, the side lip punch shown in Fig. 1 is used. This is passed into the opposite end of the bracket until the lip rests against the small ring of the case. By striking lightly upon the punch, which is moved around the ring, the case can be driven out without trouble. A case can be replaced by holding the bracket in the jaws of a vise and forcing the case to its seat.

Removing a Key.

A key or wedge is apt to stick in its seat after it has been in position for some time. Although it can be easily removed, it is yet true that the attempt to loosen it often results in serious damage to the key and also to the part in which it is placed. Fig. 2 represents a key in its position at the inner end of a crank, where it serves to bind the crank to the end of the axle. To loosen it the nut on the small end of the key is turned until

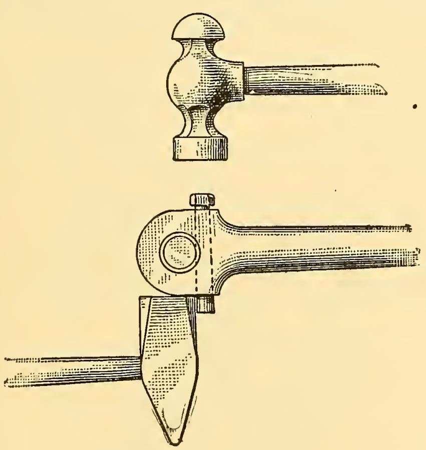


Fig. 2.—Removing a Key.

its upper face is flush with the end of the key. A heavy hammer is then held under the crank, as indicated, and the nut struck a sharp blow with a light hammer. A single blow will loosen the key in almost every instance ; raising the nut until its surface is even with the end of the bolt obviates all danger of injuring the thread of either the key or nut. If the nut is raised too high there is a risk that the threads in contact may be upset to such an extent as to render both key and nut useless.

Dog for Removing Keys.

The device shown in Fig. 3, while primarily intended for loosening keys, will find a wide range of usefulness. The threaded end of the bolt is fitted with a concave loose brass button to fit over the end of a key. This construction and

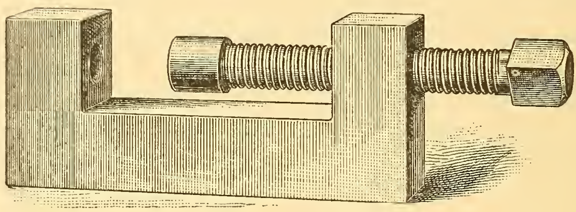


Fig. 3.—Dog for Removing Keys.

method of application obviate all danger of injuring the key, and at the same time permit of the exertion of a pressure sufficient to remove the most obstinate key.

Adjustable Crank Puller.

The crank puller illustrated in Fig. 4 can be adjusted to fit any crank. Through the center of the block D is an opening

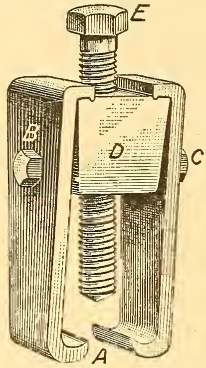


Fig. 4.—Adjustable Crank Puller.

which is threaded to receive the screw E. The lower end of the screw is cone shaped, and at the upper end is a hexagonal cap, to which a wrench is applied for turning the screw. Instead of this cap a crossbar can be passed through the upper end of the screw to serve as a handle for turning. Held to the block D by the screws B and C are two side pieces or cheeks. The upper ends of these side pieces are bent to a right angle, the bent portions resting on top of the block. The lower ends are also bent inwardly and have upwardly curved extremities A.

To use the device, the side pieces, by means of their screws, are adjusted so that the crank is carried upon the points A, the shaft hanging down and in line with the screw E. The point of the screw presses against the center of the shaft. As the crank is held firmly by the points A, the shaft will be forced out when the screw is brought to bear upon it.

Vise Used for Removing Crank Key.

A simple way of removing a crank key, and one in which there is no possibility of injuring in any way either the crank

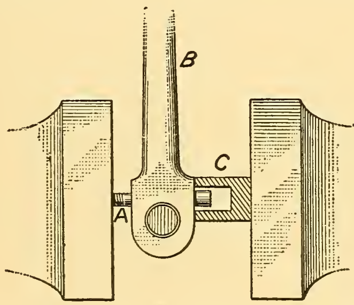


Fig. 5.—Vise Used for Removing Crank Key.

or the key, is illustrated in Fig. 5. The drawing represents a plan view of the two jaws of a vise, with the crank and block by which the key is removed in position between the jaws. The block C may be any piece of iron from 1 to 2 inches in length and from 1 to 1½ inches in diameter. A hole ½ inch in diameter is bored nearly or quite through the block, lengthwise. The block is placed against that side of the crank B from which the large end of the key projects, the small end of the key resting against the face of the jaw A. Upon the vise being screwed up the key will be forced out of the crank into the opening in the block. A small piece of ½-inch gas pipe might serve as the block, a piece of sheet brass being inserted between the block and crank to prevent injury to the latter.

False Faces for Vises.

It is frequently desirable to hold an enameled or nickel-plated frame in a vise. The rough surface of the faces of the jaws of the vise would mar the frame if some soft material were

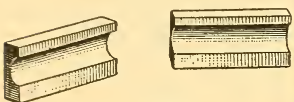


Fig. 6.

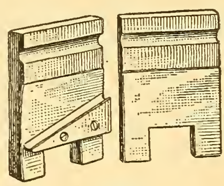


Fig. 7.

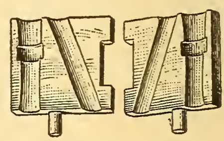


Fig. 8.

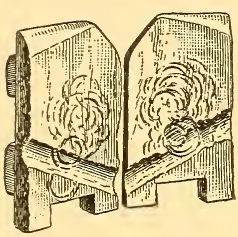


Fig. 9.

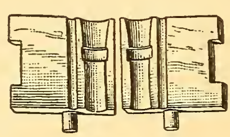


Fig. 10.

Fig 11.

False Faces for Vises.

not interposed. Cushions of thick felt have been tried for this purpose, but they have the disadvantage of soon wearing out and also of preventing the vise gripping firmly enough to prevent slipping. In addition, if the vise is screwed up sufficiently to hold the work, there is danger of the tube being flattened by the great pressure. A few false faces for vises which have given the most satisfactory results are shown in Figs. 6 to 11, inclusive. The application of one of these to the vise and the way in which it holds the frame are shown in Fig. 12. These faces, it will be observed, are made in pairs, and their meeting surfaces are so formed that when placed together the frame will be firmly grasped in the groove. The pair shown in Fig. 6 are made of cast iron, the semicircular grooves being finely finished. Faces made of iron have not been found to give the best results, mainly because there is a limit to their range of applications. They answer well for holding tubes of the exact size of the grooves, but of course cannot be applied to anything smaller, and if a tube of larger diameter is gripped the edges of the grooves are apt to injure the surface of the tube.

For these reasons they are not as serviceable as faces made of pine, shown in the illustrations, Figs. 7 to 10. The drawings show these so plainly that but little explanation is needed. The pair with two grooves at an angle with each

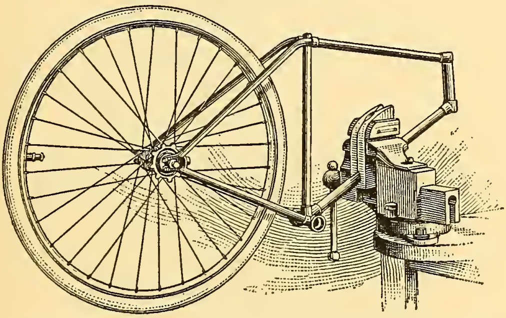


Fig. 12.—Showing Use of False Faces for Vise.

other, Fig. 8, and parallel with each other, Fig. 10, were made for a special form of frame. These faces are easily, quickly and cheaply made, are light and convenient to handle, and while holding the work as firmly as need be will not injure the finish.

The jaws shown in Fig. 11 are made of two pieces of hard wood, which are forked for a considerable part of their length in order to slip over the sliding bar of the vise. The legs of the pieces are screwed to blocks, as shown. The two pieces spread apart from the blocks toward their upper ends, and the spring thus formed serves to hold the appliance between the vise jaws. The inner upper surfaces of the two legs are covered with heavy felt. It will be perceived from what has been said that the ideas just presented can be changed and extended according to the ingenuity of the repairer.

Spring False Face for Vise.

The wooden jaws shown in Fig. 13 are held together by a spring, which normally tends to force the lower parts of the two jaws apart or away from each other. The result of this is that when the jaws are placed in the vise, as indicated in the en-

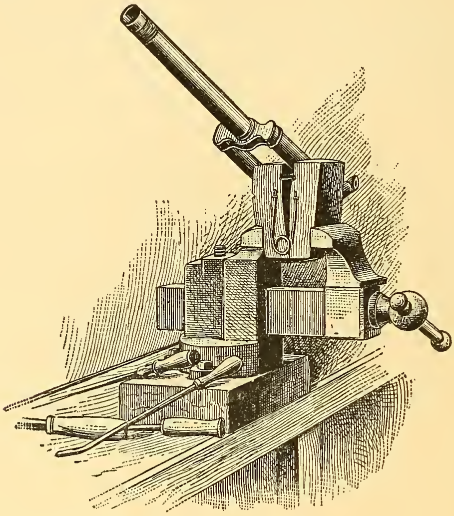


Fig. 13.—Spring False Face for Vise.

graving, they are held in position by the action of the spring. This construction makes this type of false face much more convenient to handle than those before described, in which the two parts were not united in any way.

Boring Crank.

Forged cranks now come to the repairer without having the needed holes bored in them. The location of the two large holes, one to receive the main axle and the other to receive the pedal axle, is indicated by conical depressions in the forging.

It is necessary, therefore, for the repairer to bore these two holes, and also the hole for the key or pin. The device shown in Fig. 14 was designed for doing this work. It consists of a hollow cube of cast iron, in the opening in which the ends of the cranks are free to enter. One end of the crank is inserted as shown and a small hole bored through it in the center of the conical depression. While in this position the hole for the key is also bored, the drill being guided by a hole in the back of the block and not shown in the cut. This method insures the correct placing of these holes in their relation to each other. The crank is then turned end for end and the other hole bored.

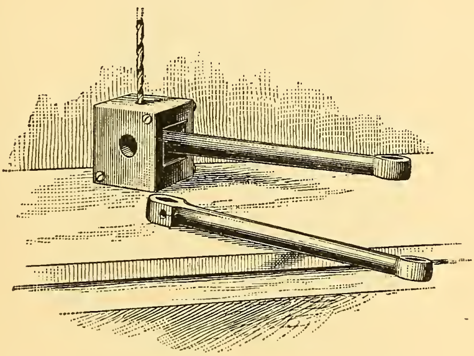


Fig. 14.—Boring Crank.

The two end holes are then enlarged to the proper size by a counterbore drill.

Drilling Hub Flanges.

In Fig. 15 is shown a simple and very useful device for drilling the holes in the flanges of hubs to receive the spokes. Mounted on a cast iron plate, which is intended to be fastened on the table of an ordinary upright drill, is a vertical standard upon which the hub is clamped. This shaft carries at its base a plate provided with holes arranged in circles concentric with the axis of the standard. These holes are accurately spaced and the several different rows contain different numbers of holes, so that the flanges can be bored with any number of holes required, 16, 18, 20, etc. Just below the standard is an adjustable bar, having at its inner end a pin which may be adjusted to enter any hole in the circular plate. This bar is held upon the cast iron base plate, the perforated plate and its standard being free to revolve about its inner end.

In using the device the base is clamped to the table of the drill in such a position as to bring the drill in proper alignment with the holes to be drilled in the hub. If 20 holes are to be

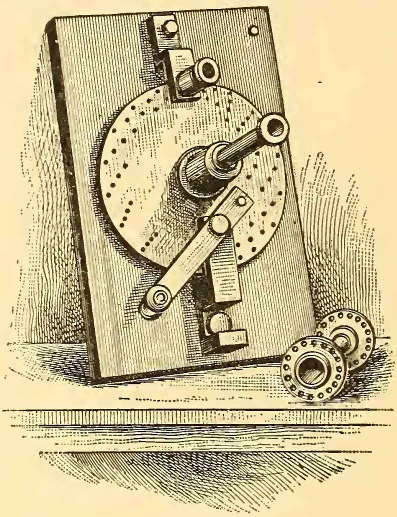


Fig. 15.—Drilling Hub Flanges.

bored the stop pin is adjusted to enter one of the holes in the row containing 20. One hole is then bored through the flange, and the gauge plate is moved one-twentieth of a circle by inserting the pin in the adjoining hole. In this way the entire number is drilled. The success of this device depends upon the correct spacing of the holes, as any inaccuracy in doing this will be repeated in the holes in the hub.

Drilling Seat Standard.

In some Bicycles the seat is carried by a bar passing through the seat standard near its top. This bar is generally placed at an angle with the standard. The jig shown in Fig. 16 is intended for boring the hole in the top of the standard at the proper angle. In the engraving the standard and its seat bar are shown with the former passed through the jig. This was done merely to show the relationship of the two parts. Passing lengthwise through the jig is a hole which guides the drill. Intersecting this hole is a second one, which is inclined with the first. The standard is inserted in this second hole and clamped in place by the bolt shown, when the hole is bored through it.

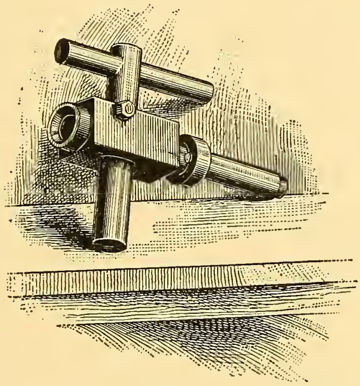


Fig. 16.—Drilling Seat Standard.

It would not pay to make this jig except in the case of a manufacturer or of a repairer for a wheel for which he had the agency.

Bar Straightener.

The tool shown in Fig. 17 will be found to be useful for straightening or for bending any pieces of solid metal. With its aid bent cranks, shafts and similar parts may be easily brought back to their original shape. It should never be applied to tubing, as the result would almost surely be the denting or buckling of the tube by the edges of the jaw. In many cases bent cranks and pedal pins can be restored without removing them.

The tool is made of a ¾-inch steel bar, bent at one end so as to form a square jaw 1 inch across. The length of the upper section of the jaw is 2½ inches and of the outer side 2¼ inches. The length over all is 24 inches. This gives a long handle, with which sufficient leverage can be obtained to do any work within

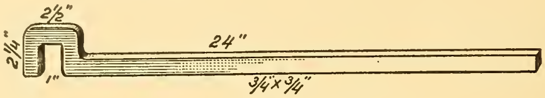


Fig. 17.—Bar Straightener.

the proper limits of the tool. If the bar of which the tool is made is square in section, the inner corners of the jaw should be filed off to a slight curve in order that the tool will not mar the piece to which it is applied. The bar to be straightened is placed in the jaw and the handle is moved in the direction to bring the bar to its original form.

Straightening Shafts or Bars in the Vise.

A convenient way of straightening shafts or bars is shown in Fig. 18. Three angles, shaped as indicated at E, are made

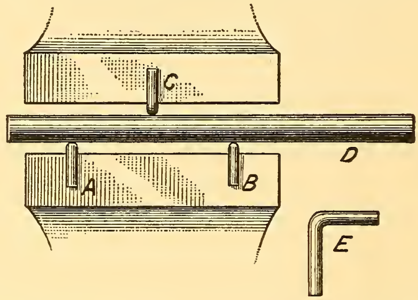


Fig. 18.—Straightening Shafts or Bars in the Vise.

of half-round or round iron. These are arranged on the jaws of a vise as indicated at A, B and C, the bar D to be straightened being placed between them. The bulging or convex side of the bar rests against the angle C. This method may be employed to advantage when the bar is too heavy to admit of handling with the bar straightener just described or when the piece is so small as to be difficult to hold.

Removing a Screwed On Sprocket.

The engraving, Fig. 19, shows how stubborn screwed on sprocket wheels, which sometimes give the repair man a vast amount of trouble, may be removed without injuring either the sprocket or shaft. The wheel is placed on the horn of an anvil, and is struck all around with a hammer. The repeated blows

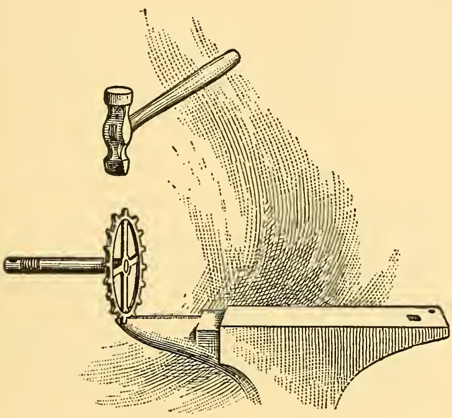


Fig. 19.—Removing a Screwed on Sprocket.

loosen the wheel, and if carefully delivered there is no danger of injury.

Truing a Sprocket Wheel.

A way of truing the driving sprocket wheel is shown in Fig. 20. The shaft carrying the sprocket is held between the centers of a lathe. A piece of chalk held against the side of the revolving wheel will mark where any distortion exists. The wheel is then removed from the lathe and struck on the chalk mark to force that portion in the opposite direction. This is continued until the chalk, lightly held against the wheel, will form a continuous mark or perfect circle In this same way it can be found out whether the axle has been sprung out of a true line or not.

Mending a Chain.

Extremely rarely does it become necessary to mend a chain by reason of the links or rivets having been broken. The operation is the same, whether a so-called stretched chain is to be shortened by the removal of one of the links or a broken link is to be replaced. One of the heads of the rivet is filed away sufficiently to admit of its being driven out of its hole. A new link is then put in place and the rivet inserted and its head hammered down. To facilitate repairs of this kind it would be advisable to keep on hand a small stock of sheet steel of which to make a new link whenever required. An old link from the same chain can be used as a guide when boring the holes in the

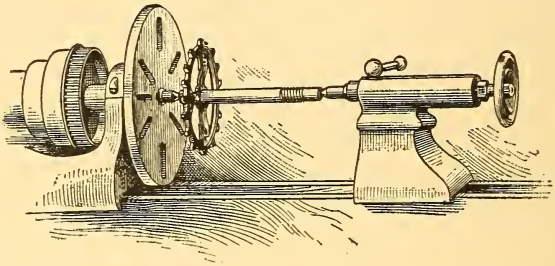


Fig. 20.—Truing a Sprocket Wheel.

new link. This insures the accurate spacing of the holes and the final easy moving of the chain over the sprocket wheels.

In some forms of chain the outer portions of the holes in the links are counter bored to receive the heads of the rivets. When this is the case the whole head cannot be filed off and boring must be resorted to. A flat spot is filed on the rivet head, and a mark made with a center punch as nearly in line with the axis of the rivet as possible. With this mark as a center the head of the rivet is drilled away until the drill meets the straight shank of the rivet, which may then be driven out.

Putting on a Chain.

The simplest way of putting on a chain is that illustrated in Fig. 21. One end of the chain is held to the large sprocket wheel, while the body of the chain is carried in the direction indicated by the arrow, back to and around the small sprocket, and the other end is brought up to the point A, where one link is placed over that tooth of the wheel immediately to the rear of the one already occupied by the last link of the other end of

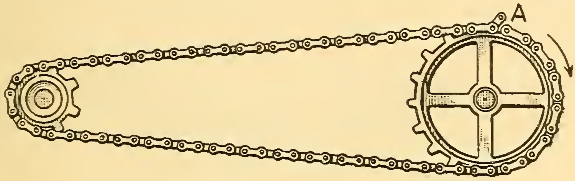


Fig. 21.—Putting on a Chain.

the chain. The free link can then be brought down to its true position and the bolt inserted to unite the two ends.

Holding Balls in Place.

In some forms of pedals trouble is often experienced in holding the balls in place until the cone has been screwed down. This may be obviated by taking a piece of paper a little longer than the circumference of the hole, rolling it into a tube and inserting it into the hole so that one end projects slightly beyond

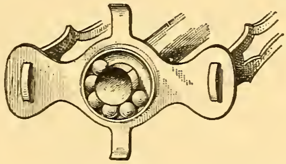


Fig. 22.—Holding Balls in Place.

the side plates, as shown in Fig. 22. This will prevent the balls from rolling into the hole.

Mending a Broken Hub.

The hub shown in Fig. 23 was broken near one of the spoke flanges. A short length of steel tubing was placed in the bore of the hub and the parts were then brazed. The integrity of a repair of this character depends upon two conditions—the thickness of the inserted steel tube and the degree of perfection of the brazing. The first is governed by the size of the axle. If the axle nearly fills the hole in the hub, so that only a thin tube can be used, the joint will be lacking in strength. The job will be useless unless a tube of ample thickness and having the requisite strength can be employed. The

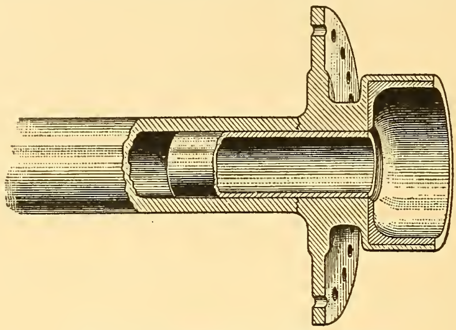


Fig. 23.—Mending a Broken Hub.

brazing should be done perfectly, and the entire length of the tube must be united to the hub in order to make a joint that will be permanent. The mere brazing of the surfaces of the break itself will do but little good.

Home Made Wire Wrench.

A home made wire wrench of very simple construction is shown in Fig. 24. Two pieces of ⅛-inch sheet steel are cut in

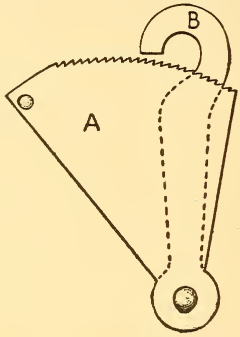


Fig. 24.—Home Made Wire Wrench.

the shape A, and the hook B is placed between these pieces and a rivet is passed through the lower ends. In the curved upper edges of the pieces A are filed teeth, as indicated. This curve is eccentric to the rivet, so that when the hook B is at its extreme right hand position a rod or pipe ¼ inch in diameter can be gripped. As the hook is moved toward the left any smaller size down to nothing may be firmly held. This tool is useful for removing radial spokes and for turning any round piece not larger than ¼ inch.

CHAPTER XII.

Enameling.

An important branch in a Bicycle repairing establishment is that devoted to enameling. There seem to be in general three divisions of enameling, when we consider solely the quality of the work done ; they are—good, bad and indifferent. Poor enameling can be done by any one and with appliances of the crudest description. Work of an indifferent character may result when the appliances are upon a more refined scale, and even when the materials are of the most perfect description. It will then be due to the inexperience and, therefore, the incompetency of the operator. The best enameling can only be done with apparatus designed and perfectly suited to the work, with materials of the highest grade and by one who has studied and understands the work he attempts. Since a reputation for otherwise excellent and, in fact, superior work in repairing may be ruined by lack of knowledge of the enameling department, it would be well to advise those who are not prepared to study the subject thoroughly and to fully equip their works with the best appliances to refuse to do enameling of any kind. At the same time the enameling branch of a repair shop may be made one of the most lucrative, and a reputation once attained for good work in this line will undoubtedly result in an increase in the business in other directions. This is due almost wholly to the fact that much of the enameling attempted in the ordinary repair shop is of an exceedingly inferior grade, for the reasons above mentioned.

In every operation connected with enameling it is of the utmost importance to preserve absolute cleanliness. This applies first to the piece to be enameled, second to the enamel itself and its application to the piece, third to the enameling oven in which the piece is baked.

In re-enameling it is first essential to remove every trace of the first or original coat. If this coat has been well put on in the first instance by the manufacturer it will be found that the old enamel is exceedingly hard and that any attempt to remove it by means of emery cloth or by scraping will be exceedingly tedious and finally ineffective. The most common practice is to soak the part in a strong solution of soda or potash, either hot or cold, the former being far preferable, and it is quicker. This soaking softens the old enamel so that it can be wiped or brushed off. In this work care should be taken to remove from all the recesses and hidden places the old enamel by means of a hard brush. In case of work which has never received a coat of enamel, grease and dirt can be removed by the same process, and where there is no danger of fire benzine can be employed with excellent results. When it is evident that all foreign material has been removed from its surface, this surface can be considered in the same light that the cabinet maker considers the surface of the piece of wood which he intends to polish. The smoother the surface is made before the finishing coats are put on the better will be the results. As a scratch on the surface of the wood of the cabinet maker would appear through his final coat of varnish, so a scratch on the metal to be enameled will finally appear and mar the surface of the final coat.

Too much attention cannot, in consequence of this, be paid to the surface of the material, nor can too much work be devoted to it in order to make it absolutely smooth before applying the enamel. There are certain enamels which do not require this excessive preparatory attention ; but, referring again to the cabinet maker, an enamel so thick that it will fill deep scratches, and which to the eye appears perfect, resembles a thick varnish, which is never used upon high class work. Enameling liquids can be purchased for a very small sum, but while they may make the work look perfect in every respect they have not the hardness and do not possess the durability of those of a higher grade, and therefore costing more money. The reason is simply that the cheaper grades cannot be sold at the price some of them are and yet contain the ingredients necessary in the perfect liquid. It is not policy to undertake enameling unless the conviction is reached to use only the best grades of liquids. The best quality of enameling liquid is comparatively thin, and yet when once baked on the metal it is hard enough to resist an ordinary scratch or abrasion, and at the same time cling so closely to the material that the latter may be bent and straightened and hammered without having the enamel come off in flakes.

The best process in Bicycle work is to bake on two or more successive coats, all of thin, high grade liquid. This gives a perfect covering, a dense color, the highest finish, and possesses the looked-for durability. Finally, it can only be said that those who attempt enameling should consult the most reputable manufacturers of the liquid, and not expect to obtain satisfactory results without the employment of superior materials, aided by skill in their manipulation.

Applying the Enameling Liquid.

After the article has been cleaned and the surface smoothed to the desired extent, the liquid should be carefully applied so as to cover every portion as evenly as possible. For doing this a brush of superior quality is necessary. The cheap bristle affair will not result in good work. With brushes such as those made of badger hair the liquid can be applied with great success. Although the liquid does not begin to set quickly under the brush, it is not good practice to brush back and forth too many times.

The engraving, Fig. 1, shows a tank in which the piece to be enameled is dipped. The tank is of such width, length and depth as to permit the complete immersion of a frame. At one side is a dripping board, placed at an angle of about 45 degrees, which catches and returns all the drippings from the frame back to the tank. The frames are dipped in the liquid and then hung on the rack over the dripping board. As soon as all surplus enamel has run off the frames are removed to the enameling oven.

Enameling Oven of Sheet Iron.

With this division of this article are presented drawings showing different kinds of enameling ovens. The one shown in

Figs. 2 and 3 consists of a sheet iron box mounted on a brick floor, in order to protect the wooden floor against fire, and measures 6 feet in hight, 4 feet in width and 3 feet in depth. At the front it is provided with a door, as indicated by the opening. Above the oven is suspended, by wires from the ceil-

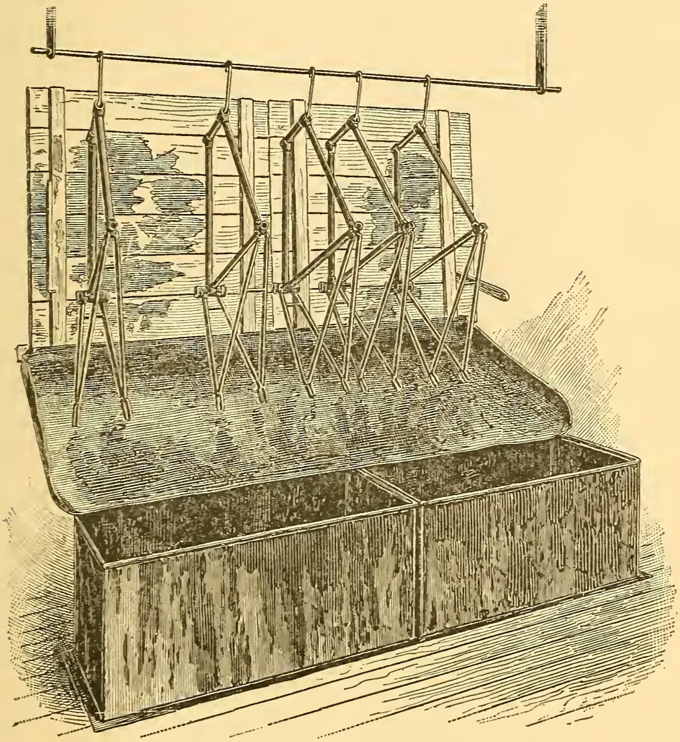


Fig. 1.—Dipping the Frames.

ing, a sheet iron plate which is larger than the plan of the oven and is designed to protect the ceiling of the room. Extending lengthwise along near the top of the inside of the oven are rods provided with S-shaped hooks, from which the work is suspended. Extending across the bottom are three multiple

Bunsen burners, which are shown enlarged in Fig. 3. Each burner consists of a 2-inch pipe provided with three rows of holes, as shown. The inner ends of these burners are closed; the opposite or outer ends extend through the side wall of the oven and are open to the air. The gas enters through the pipe

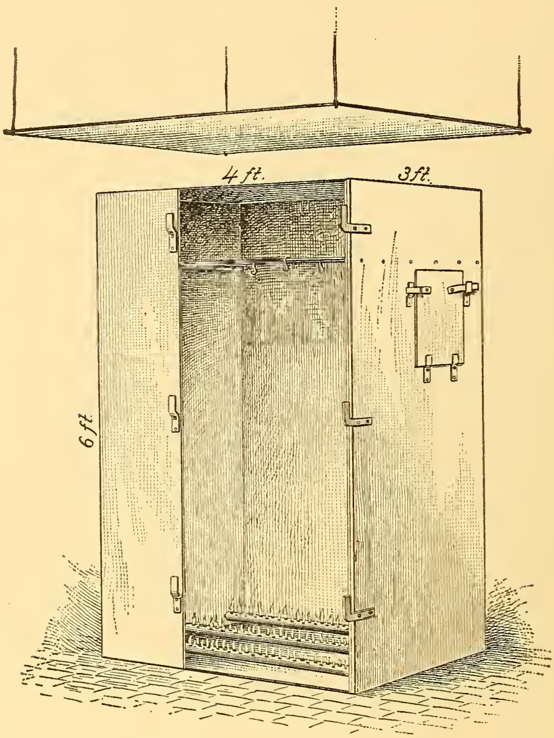


Fig. 2.—Enameling Oven of Sheet Iron.

indicated, and from the main supply pipe are three branches which enter a short distance into the main or 2-inch pipes. Each of these branch pipes is provided with a valve, as shown. Gas, under the usual pressure, enters the burner and draws in the necessary supply of air for complete combustion through the open end of the burner, as indicated by the arrows. This over has been found to give most excellent results, to be easily controlled, and by the use of either one or all of the burners to permit any degree of heat to be attained.

Brick Enameling Oven.

The inside measurements of the oven, shown in Figs. 4 and 5, are 6 feet in hight, 7 feet 4 inches in length, and 3 feet in

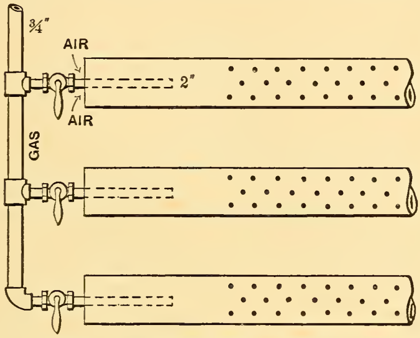


Fig. 3.—Plan of Multiple Bunsen Burner in Fig 2.

depth. It consists of a brick floor and brick end walls and a cement top ; the whole being lined with sheet iron. It is provided at the top with rods carrying hooks, and at the bottom

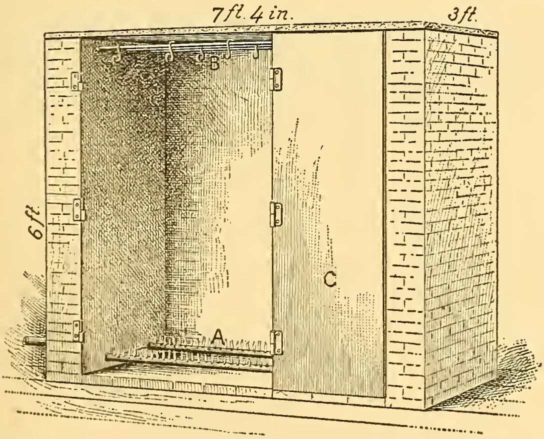


Fig. 4.—Brick Enameling Oven.

with two multiple Bunsen burners. The burner shown in plan view, Fig. 5, is used, and the whole is inclosed in a small room formed with glass sides and doors, in which all the work except the cleaning of the frames is performed. This inclosure was made in order to insure absolute cleanliness. The burner shown in Fig. 5 consists of two tubes, B and D, which enter through one of the sides of the oven at the bottom. The inner end of the tube B is formed with a right angle extension, C, and the inner part of the tube E is formed with a right angle extension, F, so that these two tubes taken together entirely surround the floor of the oven. The tubes are formed with holes as indicated by the dots. The outer ends of both of these tubes are closed, and through their closed ends enter the gas pipes from the main

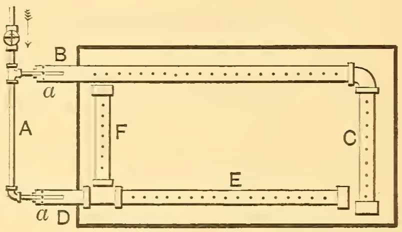


Fig. 5.—Plan of Multiple Bunsen Burner in Fig. 4.

supply pipe A. The air for mixing with the gas is drawn in through the small holes shown in the ends of the pipe at *a*.

Enameling Oven Heated from Outside.

In reality, the oven shown in Figs. 6 and 7, consists of two boxes placed one within the other, an air space of 2½ inches being left between the walls and also the ceiling. Both of these boxes are built of heavy sheet iron, lapped and riveted. The bottom of the inner or smaller box is covered with about 2 inches of asbestos, this being introduced in order that the floor may not become so highly heated as to burn the feet of the workmen. Between this floor and the floor of the outer or inclosing box is a considerable space, in which are four burners, E, radiating from a common center. These burners are of the Bunsen type, the air and gas admitted to the central tube being controlled by valves placed in the conducting pipes C and D.

An important feature is found in the method of ventilating the air space between the two boxes and also the inner box. Extending upward from the center of the top of the outer box is a pipe, A, provided with a suitable damper, which serves as a ventilating pipe for the air space between the two shells. A second and smaller pipe, B, leads from the top of the inner box through

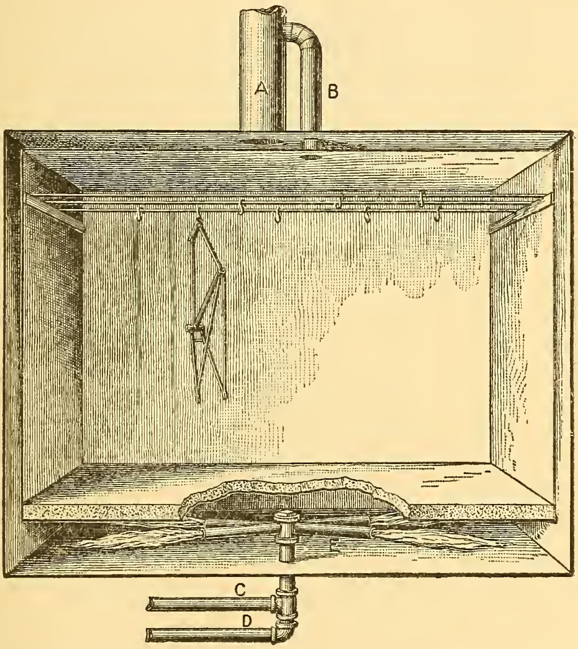


Fig. 6.—Enameling Oven Heated from Outside.

the air space and top of the outer box, and then curves and joins the ventilating pipe A. This pipe serves to ventilate the interior oven and to carry away any gases or fumes arising from the article being enameled.

For an ordinary repair shop the following dimensions would produce an oven of ample size for enameling any frame : Depth, 3 feet ; width, 4½ feet ; hight, 5 feet, all of these being measurements of the inside box ; air space, 2 inches ; space between bottoms in which burners E are placed, 7 inches; ventilating pipe A, 5 inches; ventilating pipe B, 3 inches. Both pipes A and B should be provided with dampers, those of the ordinary stove pipe pattern serving every purpose.

The gas pipe C and air pipe D might be made of 1-inch gas pipe, the vertical pipe leading to the burners of 1¼ inches and the burners themselves of ⅜ inch, all of these being inside measurements.

By properly regulating the valves controlling the admission of gas and air any required temperature can be obtained. The heat is applied evenly at all parts and the oven can be brought to the desired condition very rapidly. This oven possesses the desirable advantage of absolute cleanliness. Although the best results are to be derived when an air pressure can be obtained, this design can be used with gas at the usual pressure. In the latter case the gas should enter through the pipe D and the air through the pipe C.

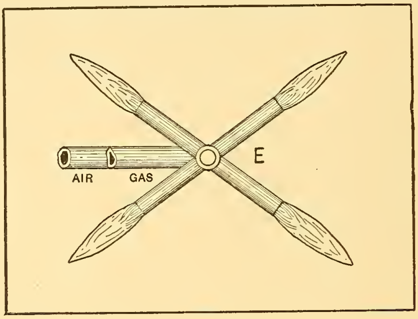


Fig. 7.—Plan View of Burners of Oven Fig. 6.

In connection with this oven is a thermometer, so arranged as to give the degree of heat in the interior, the temperature for the general run of work being maintained between 250 and 300 degrees.

Enameling Oven Heated with Coal.

The enameling oven, Fig. 8, is arranged to be heated by a stove burning either coal or wood. The dimensions are 6 feet in hight, 5 feet in width and 3 feet in depth, all of these being inside measurements. The oven should be constructed of sheet iron of about No. 14 gauge, and then covered upon all sides and top with a non-conductor of heat. For the latter purpose asbestos answers admirably, but in order to insure cleanliness it should be covered, preferably with sheet tin. This covering would serve the double purpose of preventing any dust collecting on the asbestos and would also hold the latter firmly in

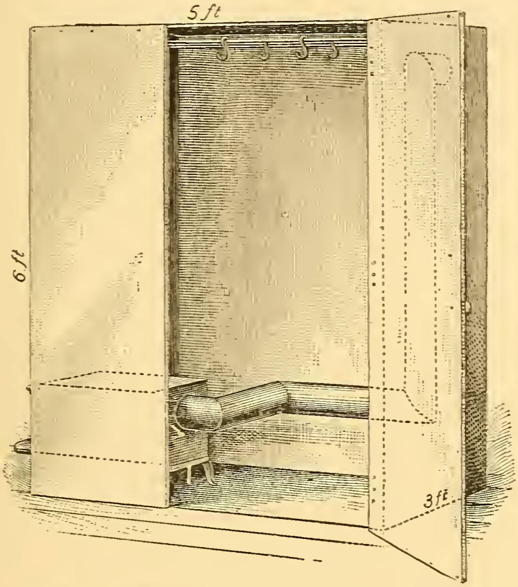


Fig. 8.—Enameling Oven Heated with Coal.

place. The interior of the oven is provided with rods carrying hooks, as described in the case of the other ovens.

The most striking difference between this oven and those previously described is found in the method of heating. In one corner of the oven is placed a small cast iron stove, having no opening inside the oven except that designed to receive the smoke pipe. This stove is fed with wood or coal from the outside, and the fire is attended and the ashes removed also from the outside.

The smoke pipe within the oven should be as long as it is possible to make it. In the engraving it will be noticed that the pipe, upon leaving the stove, bends at right angles, extends to the rear wall, along which it passes to the rear right hand corner and then extends upward, passing through the upper right hand corner to the chimney opening. This long length of pipe is introduced for the purpose of utilizing, as far as possible, all of the heat to be derived from the burning coal. An oven of large size and heated in this way has been found to give good satisfaction and to provide the necessary temperature without much trouble and to be cleanly. In a large oven an automatic damper is provided, which serves to regulate the heat and to maintain an even temperature in the oven for any required length of time. This, while it might be a refinement not absolutely necessary in the case of a small oven for general work, would undoubtedly work to the best advantage, and above all give the repairer reliable and exact information concerning the heat employed.

Electrically Heated Enameling Oven.

An extremely interesting oven, and one possessing very marked advantages, is shown in its principal features in Fig. 9. This method of heating an oven insures perfect cleanliness and provides for an easy and quick regulation of the heat, so that any desired temperature can be obtained by the mere moving of a switch. Further than this, the oven can be heated to the maximum degree in an exceedingly short time, since the full heating power can be turned on instantly. At the same time a uniform temperature can be maintained for any desired length of time.

The inside measurements of the oven itself are 8 feet long, 4 feet wide by 5 feet in hight. The usual racks are provided for holding the various articles to be enameled. The oven is incased in brick to confine the heat, even the door itself being brick, the same as the sides.

Except the front or side in which the door opening is, the inside walls carry steel strips or resistance bars, through which the current of electricity is passed, and which are thereby heated. The heating coils are made of steel tape ½ inch wide by $^{15}/_{100}$ thick.

The principle of this construction will be readily understood by reference to Fig. 9. The conductors from the dynamo lead to the switches 1, 3, 5 and 2, 4, 6, and from these switches to the several coils A. The voltage of the dynamo is 110. The electrical resistance of the heating coils with all the switches in contact is 0.44 ohm, and current 250 ampères. Now, with the switches 1 and 6 thrown in 50 ampères of current are passed

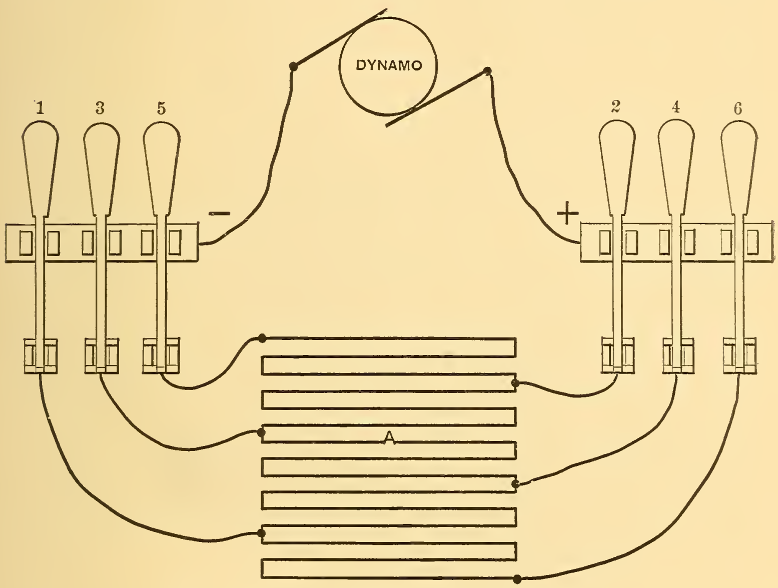


Fig. 9.—Electrically Heated Enameling Oven.

through that section of the heating coil, and with the switches 1, 3 4 and 6, 150 ampères are passed through. With the switches 1, 3, 5, 2, 4, 6, the maximum heating effect is obtained. The extreme simplicity of this construction will be perceived, and at the same time the effectiveness and close control made possible by it will be understood. Further than this, this method of heating an oven has a very wide range of application, and it can be installed without much trouble and can be adapted readily to an oven of any required size. The wide introduction of electric lighting and power stations renders it possible to equip an oven with a heater of this description in almost any locality.

All things considered, it is not probable that this oven could be run at as small a cost as those formerly described, but the superior advantages it possesses would, we think, more than offset this cost, and, as far as running expenses are concerned, very little is lost in bringing the oven up to the desired temperature, because the greatest heat can be obtained on the instant, and secondly, when the work has been baked to the desired extent the current is switched off and all expense then ceases. With an oven of this kind perfect results can be confidently expected every time, because, as mentioned, of the even running temperature and perfectly clean surroundings.

Steam Heated Enameling Oven.

An idea of the general arrangement of a steam heated enameling oven may be obtained from Fig. 10. The oven illustrated is much larger than would be required in any repair shop, but its design is such as to permit of easy modification to suit any existing conditions. The oven is heated with live steam, conveyed direct from the main boilers. The walls of the oven are made of two shells of thick sheet iron, so arranged as to form an air space between them. The top is covered with a layer of asbestos about 1 inch thick. The floor is of sheet iron, and in this instance is provided with two tracks, upon which run iron cars carrying the articles to be enameled. This would not be necessary in a Bicycle repairing shop, and the bars and hooks could be substituted as in the other ovens. Inside of the sheet iron walls are vertical rows of steam pipes, placed closely together, as indicated. Across the top are other steam pipes. Below the pipes on the ceiling is a sheet iron apron, which serves to catch any dust or dirt that might fall from the overhead pipes. Steam at boiler pressure passes through all of these pipes. It is of the utmost importance in arranging these pipes to provide for their proper drainage—that is, provision should be made for the water condensed from the steam to flow to some point where it could be drawn off.

An extremely uniform temperature can be maintained for any period in this oven. The way in which the heat is applied insures the even heating of every part of the oven. This is essential in an oven of large size, but is of minor value in one of small dimensions designed for the work of a small shop. The degree of heat to be obtained is controlled by the steam pressure available, and higher than this it is, evidently, impossible to go. But any lower temperature desired can be easily and quickly obtained and can be maintained indefinitely.

Enameling Oven Under the Sidewalk.

In a large city there is an enameling oven built under the sidewalk. The repair room is in the basement and is entered

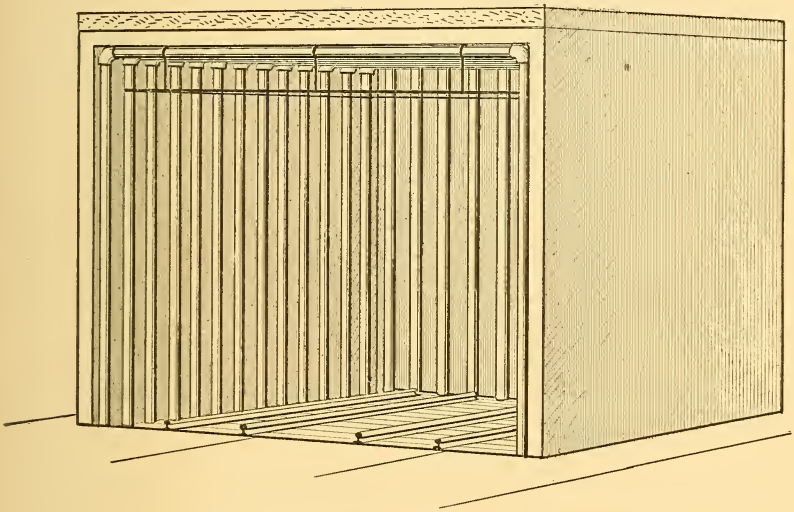


Fig. 10.—Steam Heated Enameling Oven.

from the street. The oven is built alongside the stairs and extends under the sidewalk. The sides and rear end are built of brick, the roof being a brick arch. The front is also of brick, with the exception of the space for the door, which is made of two plates of thick sheet iron. Inside of the oven are the usual racks from which the work is suspended. The oven is heated by two long perforated pipes, containing the mixture of gas and air. These burners are similar in design to those previously described.

This oven occupies space which would otherwise be of no value except for storage. There is no undue heating of the workroom, as there would be if the oven were placed in it. But, most important, the oven is economical in the use of gas, as the masonry walls and ceiling form a most effective barrier to the passage of heat. The loss by radiation through the walls is extremely small. This is shown by the long time required to cool the oven after the gas has been shut off.

To Touch up the Enamel.

To touch up the enamel, clean thoroughly with benzine, apply the enamel freely, and after it has spread out, but without waiting for it to dry, bake with the flame of a Bunsen burner, being careful to keep the frame in rapid motion. The enamel thus put on will be hard and bright and will rival the old enamel in beauty of finish.

CHAPTER XIII.

Nickel Plating.

It is doubtful if there is any other part of Bicycle work which demands more careful attention than that of nickel plating. Inferior work in this department will surely bring the entire establishment into disrepute. If the repairer is not actuated by the impulse to do the best electroplating possible, and to provide all the appliances necessary to accomplish this object, he had better drop the plating branch of the business and have work of this kind done elsewhere.

The size or magnitude of the equipment for plating depends almost entirely upon the extent of the business carried on. This will govern the capacity, and whether it should be large enough to nickel an entire frame or only the smaller parts, such as handle bars, sprockets, hubs, etc. It would seem that in the great majority of shops it would be inexpedient to equip sufficiently to handle a frame, mainly because this work is seldom asked for, while the treatment of all the small parts commonly nickeled is of frequent demand.

Arrangement of Plating Room.

The drawing, Fig. 1, represents a conveniently arranged plating room capable of doing any work that may be needed in this line. It is very evident that, although this outfit is much larger and more elaborate than commonly needed, it may be easily changed to suit the conditions prevailing. Along the left side of the room are placed the nickel and copper solutions held in tanks. About in the center of the row of tanks is placed the dynamo. The electrical conductors from the dynamo lead to two conductors placed along the wall, and from these conductors lead wires to each of the tanks, as shown. At the opposite of the room is a work bench. In the center of the room are the lye and water baths and the scouring benches. At each end of the room is a sawdust box.

Although full instructions for the complete setting up of a plant of this description will be given by manufacturers of electroplating appliances, it is better to have all the work done by the concern furnishing the machinery rather than have a novice attempt it. It may cost more to remedy a blunder than it would have cost if one familiar with the work had been engaged to do it in the first place.

Cleaning and Polishing for Plating.

In nickel plating Bicycle parts one of the most important things is to have the articles properly prepared before they are plated. If this is not done the nickel plating will peel and wear very badly, and as a Bicycle is exposed to the weather almost all the time it is essential that the nickel plating should be done in such a manner that the article will not rust through, which would be a serious defect.

In polishing handle bars or other round bent parts, endless belts and sheepskin or soft bull neck wheels are used. For cranks and other straight or flat parts hard bull neck or leather covered wood wheels are used.

These are set up first with No. 120 emery for roughing out, and with flour emery for fining. After these parts are polished on the above they are greased on felt grease wheels—that is, felt wheels set up with flour emery worn smooth and then greased or oiled. The parts are then finished on a buff with crocus or tripoli. Patent piece printers' ink buffs are recommended for this purpose on account of their hardness, which gives the fine finish necessary for this purpose.

In this connection it may be advisable to give another method of grinding and polishing iron and steel work which has also been found to give excellent results in practice.

First grind or cut down the work with No. 60 or No. 70 emery, and for finishing use a very soft wheel, such as a compressed leather wheel or a wood wheel covered with leather. If No. 60 or No. 70 emery is used for cutting down set the wheel for finishing with No. 120 emery, but if No. 90 or No. 100 emery is used for cutting down set the wheel for finishing with No. 150 emery. Work the wheel down to a smooth surface, then rub or charge the wheel well with Bayberry tallow and work down to a smooth surface before using it on the work.

If a very high and fine finish is desired for Bicycle parts before plating, then it is advisable to use the wheel set with flour emery paste, the operation of finishing being the same as

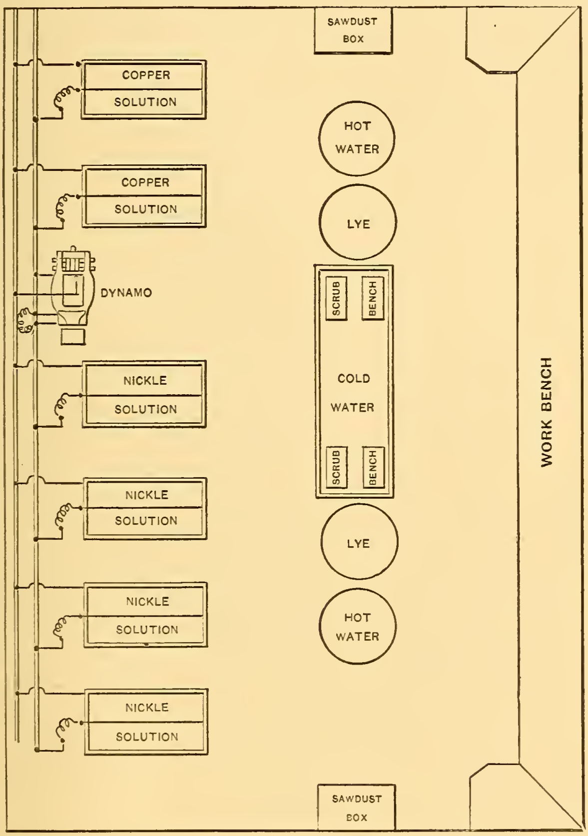


Fig. 1.—Arrangement of Nickel Plating Room.

with the No. 120 or No. 150 emery, the emery paste being used after the No. 150 emery.

To prepare the emery paste make the glue only one-half the usual consistency, then add sufficient quantity of flour emery to make the mass the usual thickness of glue, and apply to the wheel with a brush when very hot. Make but little at a time, as it soon spoils.

In polishing tubular work, such as handle bars, etc., use first the strap set in No. 70 to No. 100 emery, the canvas strap being the better. To finish, use walrus hide wheels, varying in width from ¾ to 1¼ inches and 3 to 5 inches in diameter, turning the walrus wheel concave enough to let the work slide easily in the groove.

Plating the Bicycle Parts.

The parts, after being polished as above, are taken to the plating room. As iron and steel when nickel plated and exposed to the weather are apt to rust through the plating, it is important to copper plate all such articles before nickel plating them.

The parts are first wired, or put on racks or pieces of wire bent in such a way as to hold the different parts securely in the solution and while cleaning. They are then dipped in a hot solution of salicornia lye for from 10 to 15 minutes. This will remove all the grease or oil. They are then thoroughly rinsed in cold water and scoured with fine pumice stone, using a platers' brush. They are again rinsed in water and then dipped into an acid solution, usually composed of oil of vitriol diluted with water. This will remove any oxide that may have been formed. They are again rinsed in water and are at once placed or suspended in the copper solution and are plated for from 10 to 20 minutes, according to the thickness of the deposit required and the strength of the current used. They are then taken out, rinsed in cold water, then plunged in boiling water, and dried in boxwood sawdust. They are then removed and taken to the buffing room, where they are colored on an unbleached muslin buff with snowflake polish or rouge.

They are now returned to the plating room to be nickel plated. The parts are again wired up as before, placed in the hot solution of salicornia lye for a few minutes to remove the dirt and grease from the buffing operation, again rinsed in cold water, and are this time brushed with whiting. Rinsed thoroughly in water, dipped in a weak solution of cyanide of potassium to remove any oxidation or tarnish, they are again rinsed in cold water and placed at once in the nickel solution. They remain in this solution from three-quarters of an hour to one and a half hours, depending on the thickness of the deposit required and the strength of the electric current employed. They are then removed from the nickel solution, rinsed thoroughly in cold water, plunged in boiling water, and dried in boxwood sawdust as before. They are again taken to the buffing room and are finished or colored upon a soft buff, which is usually an unbleached muslin buff, with snowflake polish. The above is the latest and most improved method of polishing and plating Bicycle parts, and the results obtained have been very satisfactory.

The Electric Current.

Regarding the electric current to be employed to plate these articles, it is necessary that the proper voltage (intensity of current) should be employed, and also that the solution should be of the proper strength and made in the proper manner.

As large an anode surface should be employed for nickel plating as it is possible to get, because the resulting metal which is plated on these articles must be very white in color, homogeneous and adherent.

This is best accomplished by having a large anode surface, as nickel is so difficult to dissolve it is harder to keep the solution supplied with metal than other solutions, and consequently if a large anode surface is not employed the solution will become weak in metal, and the plating will then turn out badly and be dark in color, which will necessitate the frequent addition of nickel salts to the solution. Also, when a very large anode surface is employed the electric current can be weaker and still the results will be satisfactory.

CHAPTER XIV.

Keeping Track of Work.

The desirability of adopting some method of keeping track of the work being done will not be disputed. No matter what system may be adopted, it should be simple; it should provide for the quick and ready identification of the wheel being repaired and of all the parts belonging to any particular wheel; it should furnish an accurate account of all the stock parts used and the labor expended, and should give the cost of the parts and the charges for labor; the bookkeeping should be the simplest possible.

All of the following engravings of tags are exactly two-thirds the size of the originals, and all are made of heavy manila paper.

Duplicate Tag.

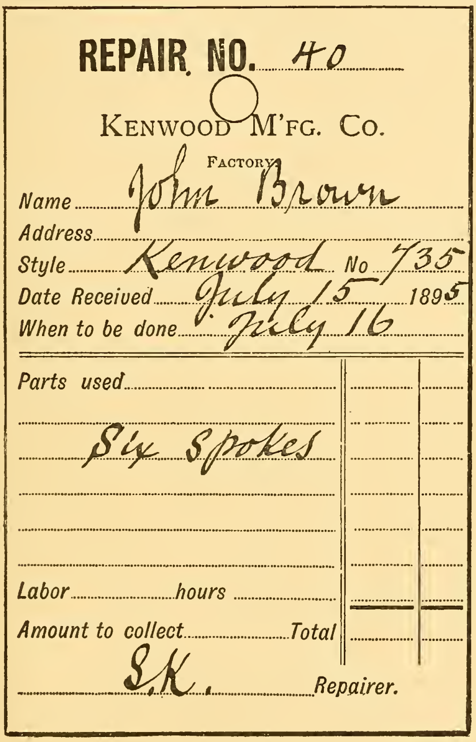
The first tag, Fig. 1, is used in duplicate, the party bringing in the Bicycle, or part, for repairs being furnished with the duplicate simply bearing his name and address and the number and style of his wheel. Details and instructions are written on the tag kept in the shop, and the charges for the work are also placed on this tag. The duplicate must be presented before the wheel will be delivered.

Tag with Stub.

The next tag, Fig. 2, is on the same principle as that just described, but in arrangement it is different. It consists of a card 8½ inches long by 3½ inches wide, the bottom being in the form of a stub which is torn off and given to the owner of the wheel. On both check and stub are written the name of the wheel, number, date received and date to be finished. A description of the work done is written on the check. The estimated cost of repairing is placed on the stub.

Tag with List of Parts.

The engravings, Figs. 3 and 4, show a tag possessing several novel features. The tag is perforated near the middle so that the stub can be torn off and handed to the owner. Both stub and check are made out alike and carry the shop number of the job, the date of receipt and when promised, the name of



REPAIR NO. 40

KENWOOD M'FG. CO.

FACTORY

Name John Brown

Address

Style Kenwood No 735

Date Received July 15 1895

When to be done July 16

Parts used

Six Spokes

Labor .... hours

Amount to collect .... Total

S.K. Repairer.

Fig. 1.—Duplicate Tag.

the owner and the instructions. On the back of the tag are printed the names of all the parts of a wheel, and columns are provided for entering the cost of the work done. When this list has been filled out it forms an accurate record of the work done and effectually bars out any dispute which might arise in the future as to the repairs made if the machine should be brought back for any claim for defective work. Whether the stub handed the owner should bear the address of the repairer or not is an open question.

HOWARD A. SMITH & CO.,
NEWARK, N. J.

Rec'd July 3 1895
Number 71
Description Excelsior
Repairs

Rim and
spokes, front
wheel

Finished July 6

BRING THIS CHECK WITH YOU.

HOWARD A. SMITH & CO.,
518 Broad St., Newark, N. J.
All repairs left over 30 days subject to storage.

Date Received July 3
Repair No. 71
Machine Excelsior
To be Done July 6
Estimated Cost

Fig. 2.—Tag with Stub.

SEE OTHER SIDE FOR REPAIRS.

No. 90

Received July 25

The Wilkins Toy Co.

BICYCLE REPAIR DEPARTMENT.

M John Smith
Keene
N. H.

When wanted Aug. 1

Remarks Make all needed repairs

RETURN THIS STUB TO OFFICE.

No. 90

M John Smith
Keene
N. H.

When repaired July 26

Repaired by Henry

Delivered Aug. 1

Remarks Make all needed repairs

Fig. 3.—Tag with List of Parts.

	Price			Price	
Cleaning,			Japan Frame,		
Cement Tires,			" Fork,		
Repair Valves,			" Wheels,		
Patch Tubes,			New Crank,		
Repair Punctures,			" Crank Shaft,		
True Wheels,			" Chain,		
Spokes,			" Links;		
Nipples,			" Link Bolt,		
Balls,			" Pedal Pin,		
Straighten Fork,			" Handle,		
" Frame,			" Grips,		
" Crank,			" Cones		
" Pedal Pins,			" Rear Hub,		
" Wheel Rims			" Front Hub,		
" Handle Bar,			" Crank Sprocket,		
Tires,			" Rear Sprocket,		
Inner Tubes,			Braze Frame,		
Valves,			" Fork,		
" Stem,			" Handle Bar		
Crank Pin,			New Tube,		
Nnts,			Repair Sprocket,		
Wood Rims,					
Metal Rims,					
Sprocket Key,			Time Hours,		
			Total		

	Price			Price	
Cleaning,			Japan Frame,		
Cement Tires,			" Fork,		
Repair Valves,			" Wheels,		
Patch Tubes,			New Crank,		
Repair Punctures,			" Crank Shaft,		
Trne Wheels,			" Chain,		
Spokes,			" Links,		
Nipples,			" Link Bolt,		
Balls,			" Pedal Pin,		
Straighten Fork,			" Handle,		
" Frame,			" Grips,		
" Crank,			" Cones,		
" Pedal Pins,			" Rear Hub,		
" Wheel Rims			" Front Hub,		
" Handle Bar			" Crank Sprocket,		
Tircs,			" Rear Sprocket,		
Inner Tubcs,			Braze Frame,		
Valves,			" Fork,		
" Stem,			" Handle Bar,		
Crank Pin,			New Tube,		
Nuts,			Repair Sprockct,		
Wood Rims,					
Mctal Rims,					
Sprocket Key,			Timc Hours,		
			Total.		

Fig. 4.—Back of Fig. 3.

Several methods of marking the wheel on the tag are followed. Some repairers give the wheel a number and it is

KIMBALL & WORRICK,
BICYCLE REPAIRING,
ALL WORK GUARANTEED.

Name . . Herman Enos
Address . . . . . Poultney . . . .
Date of Order . . 8/2 . . . .
Name of Wheel . Flower City .
Number of Wheel . . 6594 . . . .
Name of Tires Hart. Single Tube

PRICE.

2 New Spokes . . . . $
7 New Balls . . . .
New Pedals . . . .
1 New Nipples . . . .
New Valve . . . .
New Handles . . . .
New Inner Tube . . . .
New Tires, (Single Tubes) . . . .
New Rims, (Wooden) . . . .
New Crank Shaft . . . .
New Pedal Crank . . . .
✓ Repair Chain . . . .
Repair Pedal . . . .
Repair Valve . . . .
Repair Puncture . . . .
Repair Handle Bar . . . .
✓ True Front Wheel . . . .
True Rear Wheel . . . .
True Frame . . . .
Enamel Frame . . . .
✓ Clean Wheel . . . .
Total . . . .
Remarks . . . .

Date Completed . . 8/3 . . . .
Workman . . Wilkins . . . . . .

Fig. 5. Card with Schedule.

known in the shop only by this number. Others add the name of the wheel. Still others designate the wheel by its name and its own number, this number then constituting the shop number. The objection to this plan is that it is not always easy to quickly find the manufacturer's number, and the shop accounts are more confused as there is such a wide variation in the num-

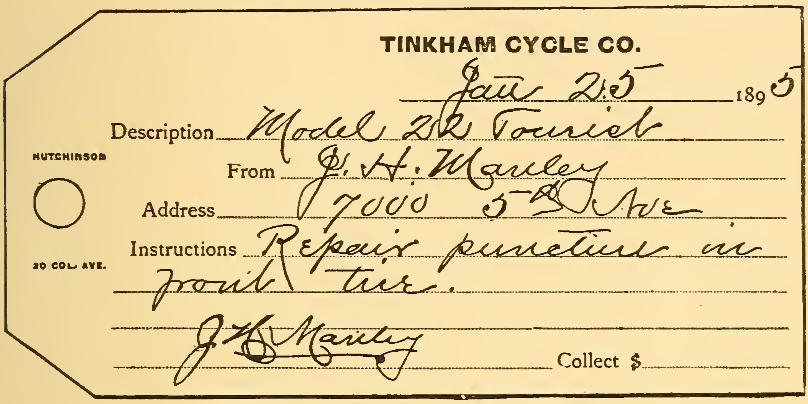


Fig. 6.—First Tag.

bers. Perhaps the simplest way is to give the name of the wheel and assign to it the next number in order on the repair book.

A point upon which too much stress cannot be laid is the importance of having the work finished when promised. Punc-

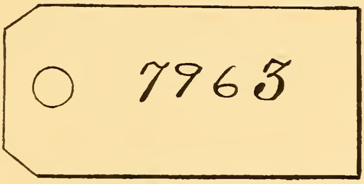


Fig. 7.—Tag for Part Removed from Wheel.

tuality is almost as important as the quality of the work done, and if a repairer once gets the reputation of being slow and repeatedly fails to produce the wheel on time his trade will suffer seriously. He must be careful when the job comes in to name a date when he is sure to have the task completed. Riders are impatient and particularly dislike to be disappointed.

Card with Schedule.

The card shown in Fig. 5 is very similar to the one previously illustrated in Figs. 3 and 4. The most common repairs are enumerated and a column is provided for the cost of each. Upon the top of the card are entered the name and address of the owner of the wheel, the trade name of the wheel, the manufacturer's number and the directions. Recording the wheel in this way is an aid in identifying it in case it is lost and the owner has no account of the number, etc.

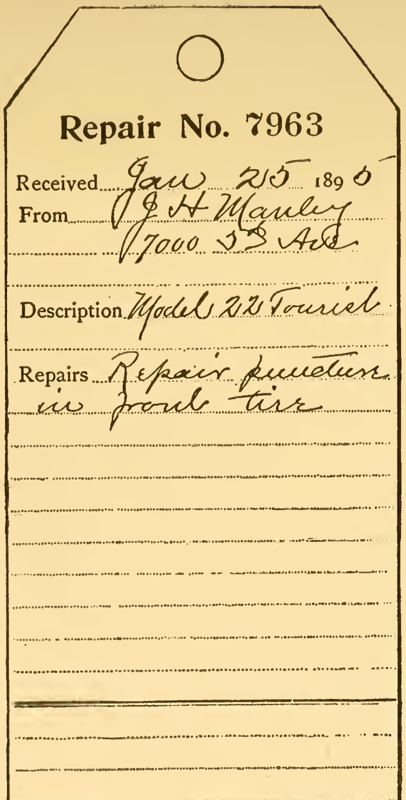
An Elaborate System.

The other engravings, Figs. 6 to 11 inclusive, represent a more elaborate system than any heretofore described, and one which has been found to be well adapted to the requirements of a shop doing a large repair business. While at first glance it may appear to be rather complicated and to require too much writing, it is in fact extremely simple.

The first tag, containing the name and address of the owner and the directions, is tied to the wheel when it enters the shop. At the lower left hand corner of the tag the owner signs his name. This serves as a check in case there should be any dispute when the wheel is delivered.

The second tag is placed on the wheel when it enters the repair department. This tag names all the parts of the wheel which have been removed as a matter of convenience. In this particular case the lamp has been taken off, and this should have been noted in the engraving, Fig. 8, but was inadvertently omitted. At this stage the wheel also receives a shop number, 7963. Every part removed from the wheel receives a small tag, Fig. 7, having the shop number upon it. When the wheel returns to the delivery room the tag Fig. 10, shows that an "S, L. Lamp" belongs to the wheel, and the small tag serves to identify this lamp. Fig. 9 is the back of the second tag and on it the charges are entered. The last tag is stamped "paid" when the wheel is delivered.

Upon the ledger are entered the name, directions and charges, the form used being shown in Fig. 11. While the directions in this instance were "repair puncture in front tire."

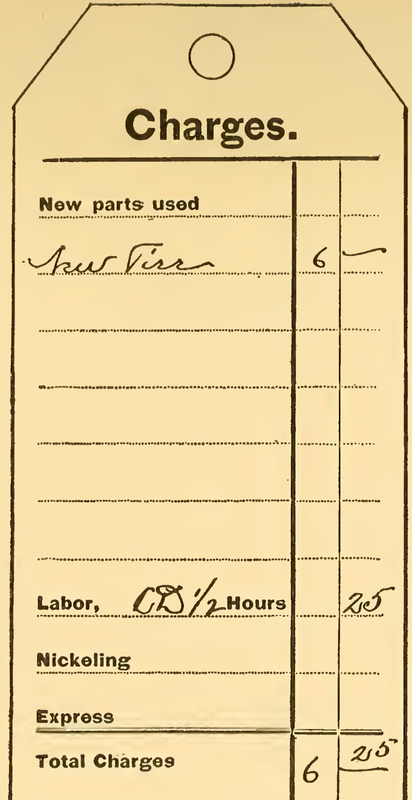

Repair No. 7963

Received Jan 25 1895
From J H Manley
7000 S S Ave

Description Model 22 Tourist

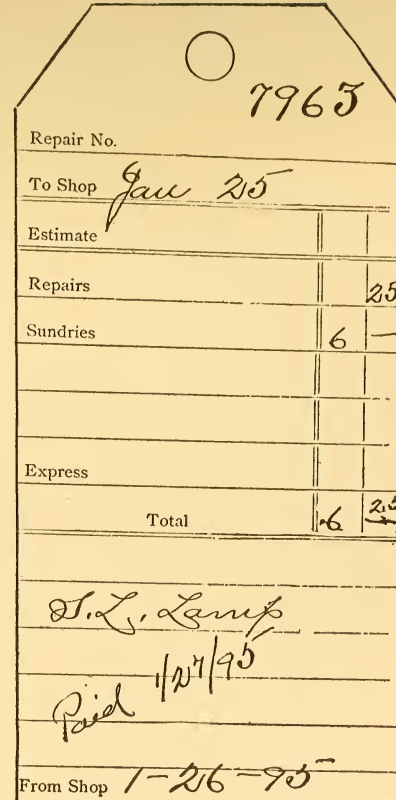
Repairs Repair puncture in front tire

Fig. 8.—Second Tag.


Charges.

New parts used		
New Tire	6	—
Labor, CD 1/2 **Hours**		25
Nickeling		
Express		
Total Charges	6	25

Fig. 9.—Back of Fig. 8.


Repair No. 7963

To Shop Jan 25

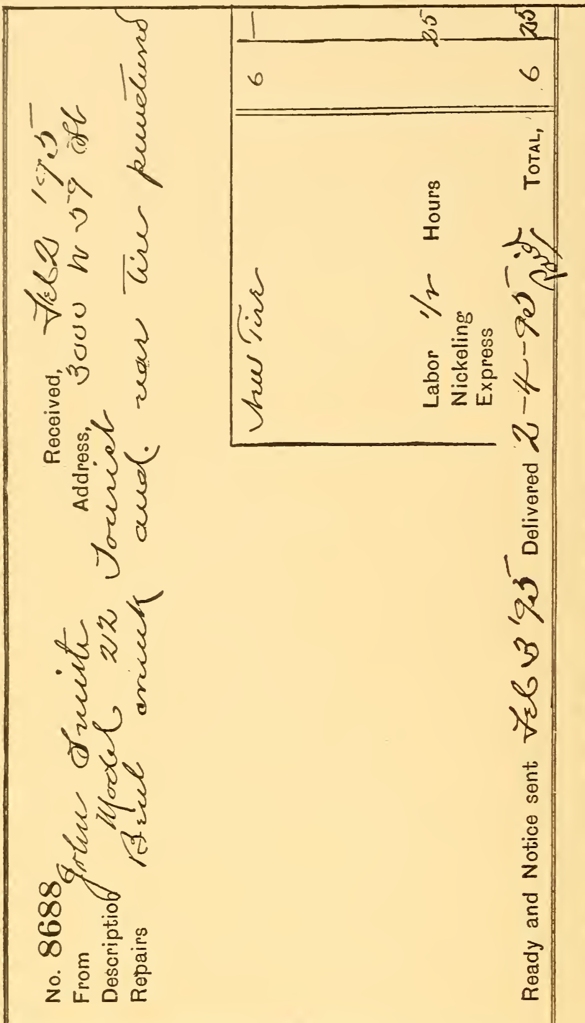
Estimate		
Repairs		25
Sundries	6	—
Express		
Total	6	25

T. L. Lamp
Paid 1/27/95

From Shop 1-26-95

Fig. 10.—Third Tag.

the charges show that upon examination a new tire was found to be necessary. All the tags are kept one month, as a precaution in case of dispute, and are then destroyed.



No. 8688 Received, Feb 2 '95
From John Smith Address, 3000 N 57 St
Description Model 22 Tourist
Repairs Bent crank and rear tire punctured

New Tire	6	—
Labor 1/2 Hours		25
Nickeling		
Express		
Total,	6	25

Ready and Notice sent Feb 3 '95 Delivered 2-4-95 Paid

Fig. 11.—Ledger Account.

Charging.

The usual practice in Bicycle repairing is to charge the retail price for the parts furnished and 50 cents an hour for the time employed upon the job. Some repairers, as a bid for trade, repair all wheels which they have sold, and wheels for which they have the agency, at the actual cost of doing the work.

Although the owner of the Bicycle almost always wants to know in advance what the repairs will cost, it is an exceedingly difficult matter for the repairer, in a quick examination, to arrive at an estimate which is just to himself and to his customer. The more the wheel is damaged the harder it is to guess at the cost. Repairers are therefore divided in opinion concerning the advisability in all cases of naming the cost before the work has been finished. The owner of the wheel almost invariably describes just what he wants done, and very rarely does he leave the repairing to the judgment of the workman with instructions to "fix everything necessary." This practice increases the difficulty under which the repairer labors when naming the price in advance. If the work costs more than the estimate there is apt to be trouble when the wheel is delivered, and also if defects are found which should be remedied, but which were not mentioned by the owner and they are not repaired because not ordered, there is the possibility of further trouble. Thus the repairer is not left free to pursue the course his experience tells him is the best for all concerned. On this point we may mention the fact that one of the largest Bicycle manufacturers in the country has an inflexible rule to make no repairs not specifically ordered. In other words, the instructions of the owner are followed to the letter.

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