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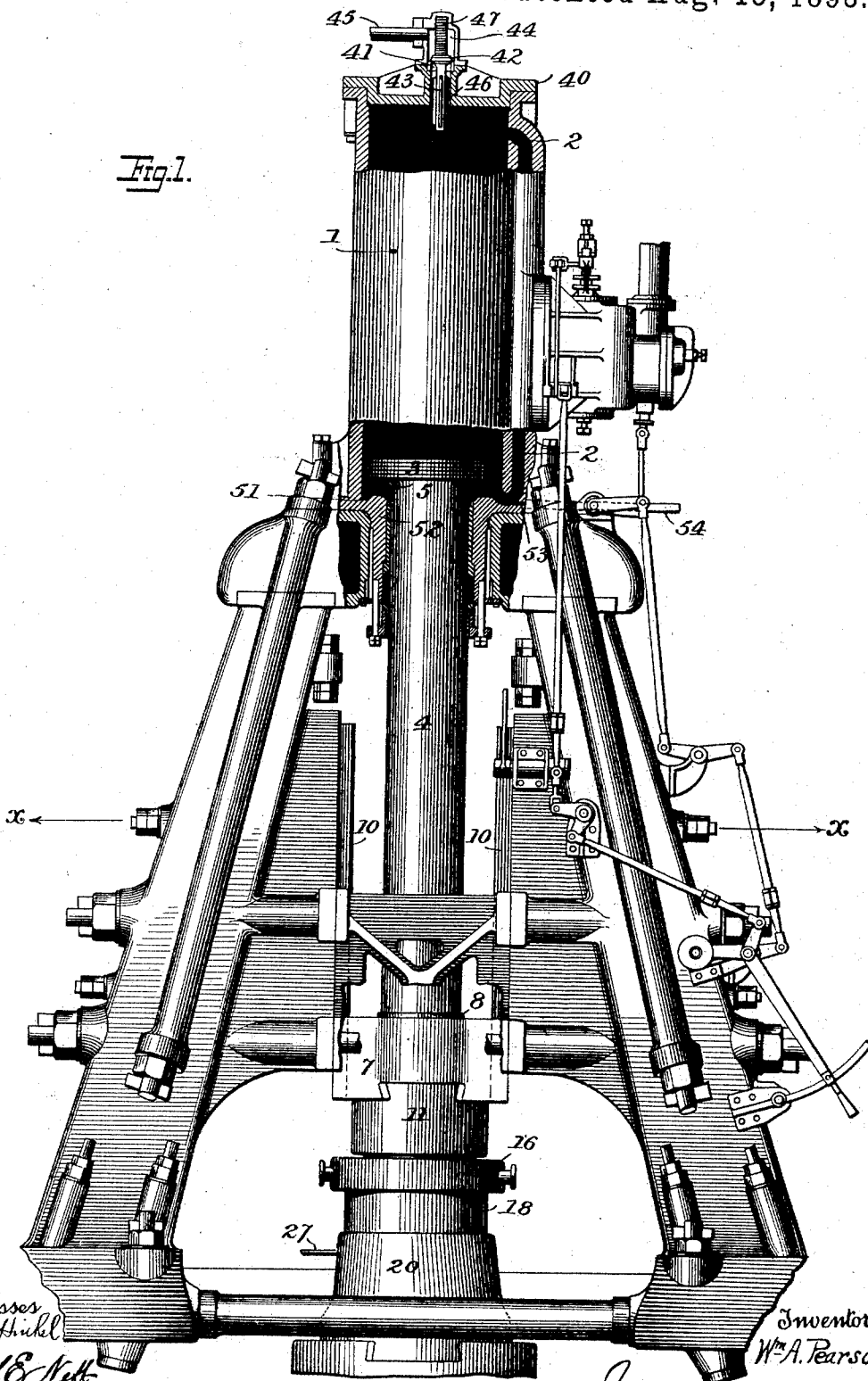
4 Sheets—Sheet 1.

W. A. PEARSON.
STEAM FORGING MACHINE.

No. 503,354.

Patented Aug. 15, 1893.

Fig. 1.



Witnesses
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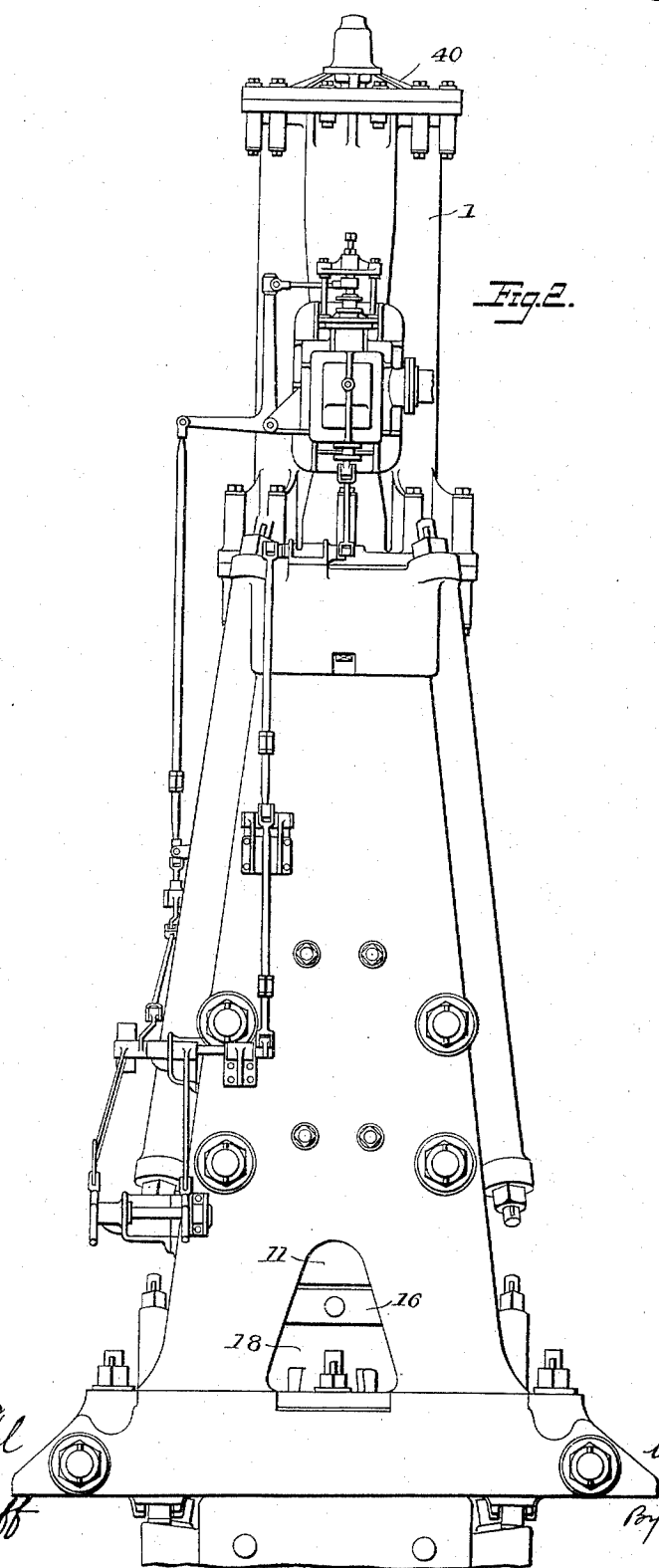
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(No Model.)

4 Sheets—Sheet 3.

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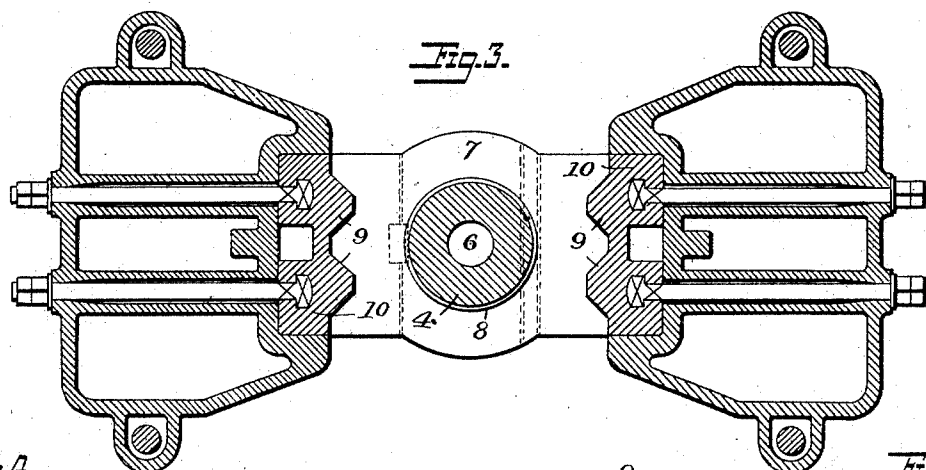
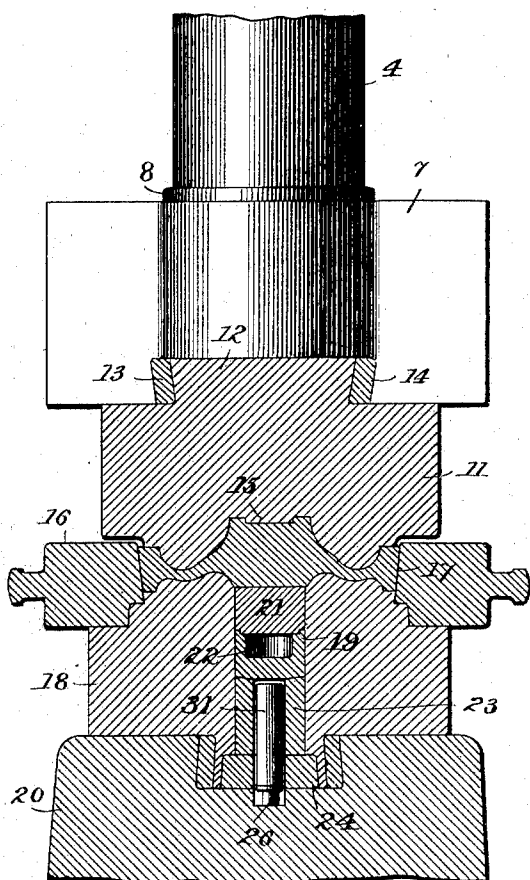
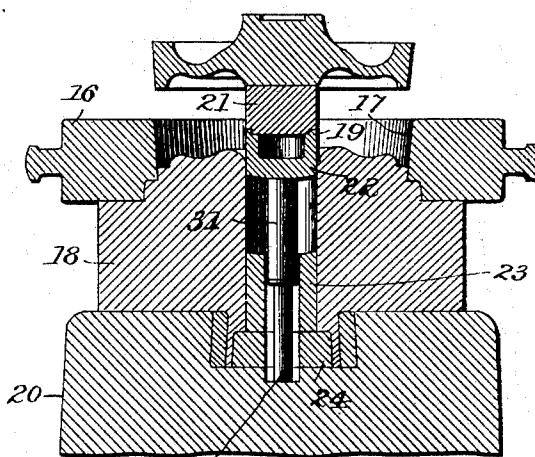
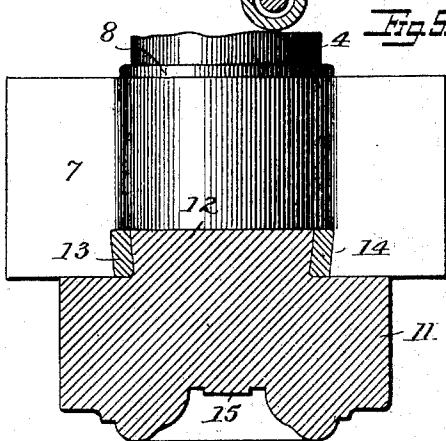


Fig. 4.



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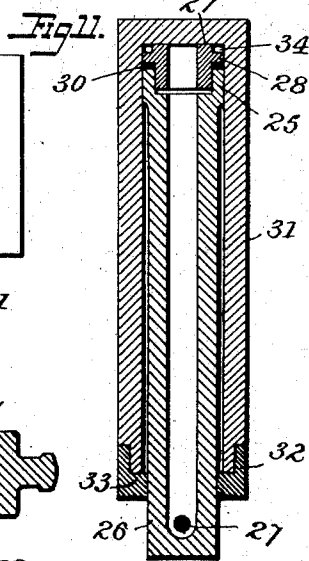
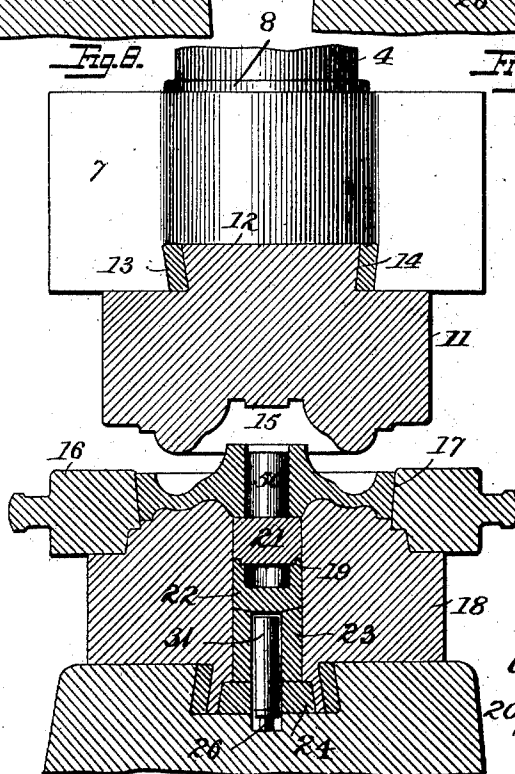
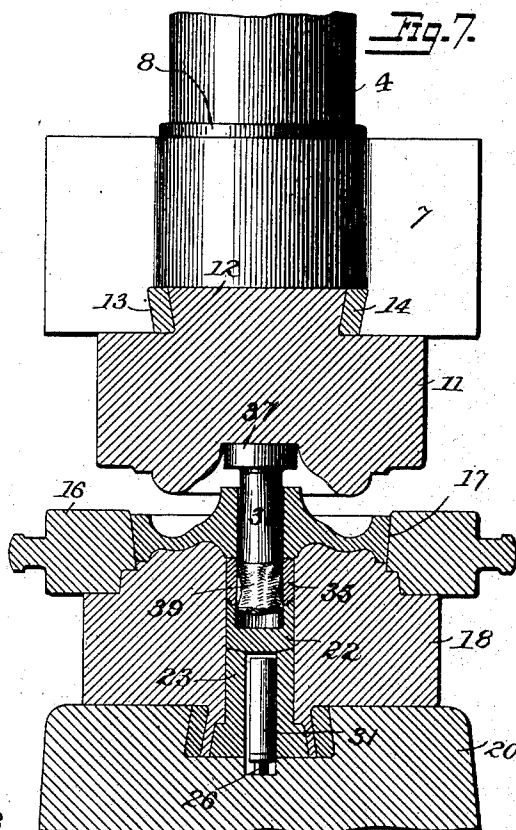


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4 Sheets—Sheet 4.

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UNITED STATES PATENT OFFICE.

WILLIAM A. PEARSON, OF SCRANTON, PENNSYLVANIA.

STEAM FORGING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 503,354, dated August 15, 1893.

Application filed October 7, 1892. Serial No. 448,158. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. PEARSON, a citizen of the United States, residing at Scranton, in the county of Lackawanna and State of Pennsylvania, have invented certain new and useful Improvements in Steam Forging-Machines, of which the following is a specification.

My invention relates to an improved forging machine for the manufacture of car wheels and similar articles from blanks of malleable metal, such as steel or iron.

In the accompanying drawings, which form a part of my specification, Figure 1 is a front elevation of the machine, parts being broken away to show the internal construction. Fig. 2 is a side elevation of the same. Fig. 3 is a cross section on the line $x-x$ of Fig. 1. Fig. 4 is a central sectional view of the dies and adjacent parts inclosing a wheel blank. Fig. 5 shows the wheel center raised to permit the solid disk under the hub to be exchanged for the punch die. Fig. 6 is a similar view showing the punch in place ready to be struck by the upper die. Fig. 7 shows the position of the parts after the punch has been driven through. Fig. 8 shows the solid disk replaced under the hub and a cylindrical block within the hub, the parts being in position to receive the finishing stroke or strokes which correct any distortion of the wheel center caused by the punch. Fig. 9 is a sectional view of the punch head. Fig. 10 is a side view of the punch proper, and Fig. 11 is an enlarged central section of the cylinder and piston of the hydraulic lift.

My invention is particularly adapted for forging articles which require considerable force and great accuracy in the forging machinery.

Many of the features of the invention hereinafter described are especially adapted to the manufacture of car wheel centers while other features have a more general use in the art of forging. It will be understood that in claiming features of the latter class I desire to cover them for all purposes to which they may be applicable.

It has been common in steam hammers, steam forges and the like to use a light piston rod and concentrate the necessary weight in the tup on the end of the piston rod which

carries the die, or in the hammer head, the tup or hammer head being guided throughout the stroke. I have found in practice that such an arrangement is both costly and inconvenient for the reason that every stroke of the hammer or die imparts a shock and a quivering movement to the piston rod, causing it to crystallize and eventually to break, and entailing heavy expense for renewal besides considerable delay to the works.

Another old construction is that in which the weight necessary for striking the blow is in the piston rod which is made of large diameter, and the hammer head or tup and the piston are made comparatively light. In this variety of hammers the piston rod is relied upon to guide the hammer or die to the proper point. For the purpose of making car wheel centers and other forms requiring great accuracy in the application of the die I have found that such a piston can not be depended upon unaided by guides. In the apparatus hereinafter described however I have combined a comparatively light piston and tup or die holder with a strong and heavy piston rod, and I have provided guides for the tup or die which guide it during its entire stroke so that the blow of the die is delivered with the utmost accuracy, while at the same time the piston rod is practically indestructible, and the blow is more effective because the weight is concentrated in the piston directly above the blank instead of overhanging the blank as is the case where the weight is in the tup.

Referring to the drawings, 1 indicates the steam cylinder which is supported upon a suitable frame-work. The cylinder is provided with steam ports 2 the lower port being at the extreme lower end of the cylinder and the upper port being located at some distance below the upper end of the cylinder for a purpose to be hereinafter explained.

The slide valve and various connections between said valve and the hand lever for controlling the machine may be of any desired construction. Those shown in the accompanying drawings are not of my invention and need not therefore be particularly described.

The piston 3 is preferably made integral with the piston rod 4 and it is constructed as light as possible considering the strains to which it is subjected. In order to prevent

the periphery of the piston from being bent downward due to the sudden arrest of its motion, the piston rod is preferably flared out where it joins the piston as shown at 5, thus providing a better support for the latter. The piston rod is preferably hollow, experience having shown that this form is more durable than a solid rod. The upper and lower ends of the rod are permanently closed by plugs 6.

To the lower end of the piston rod is connected a tup 7 in any suitable manner. As shown in the drawings a slightly tapered bushing 8 surrounds the piston rod, and the tup, which has a correspondingly tapered opening, is secured thereto either by driving or shrinking it upon the tapered bushing. The tup is designed to hold the die and it is only large enough to give it sufficient strength, its weight being inconsiderable in comparison with the weight of the piston rod. As best seen in Fig. 3 the tup is provided at its ends with vertical grooves 8 which fit vertical guideways 10 upon the main frame. These guideways extend the entire length of the stroke of the tup, thus preventing any vibration of the die and directing it with accuracy.

The dies for forming the forging (which in the present instance is a wheel center) and the punch for punching the central hole will now be described. The upper die 11 is rigidly connected to the tup. As shown the connection is formed by dove-tailing a shank 12 of the die into the lower surface of the tup. The die is held from movement in one direction by a dowel block 13 which occupies a recess formed partly in the tup and partly in the shank 12. On the side of the shank opposite the dowel pin a slightly tapered key 14 is inserted, thus preventing any movement of the die in the other direction and securing it rigidly to the tup. The lower surface of the die conforms to the desired contour of one side of the wheel center. A novel feature of this upper die consists in a central teat or projection 15 upon the face of the die which forms a corresponding depression in the hub of the blank adapted to center and hold the punch which is afterward used to form the hole through the hub. The wheel center is formed within an annular matrix 16, the inner face 17 of which is tapered and conforms exactly to the peripheral surface of the finished wheel center. This matrix rests upon a shoulder or shoulders of the lower die 18. The lower die has a vertical well 19 directly beneath the hub of the blank and about equal in diameter to said hub. The upper surface of the die between the well and the matrix is shaped to correspond with the contour of the under side of the wheel center. The lower die 18 rests upon an anvil block 20 to which it is secured in any suitable manner. The securing devices are preferably the same as those above described for attaching the upper die to the tup.

Within the well 19 and suitably supported is a solid disk 21 upon which the hub of the

wheel center is formed and which really forms a part of the lower die when in place. The disk 21 rests upon a second cup-shaped disk 22 which in turn rests upon a cylindrical support 23 having a broader base 24 which rests upon the anvil block 20. The parts 23 and 24 may be either integral or separate, as desired. The parts 21 and 22 fit closely within the well but are removable therefrom. The parts 23 and 24 are not designed to be removable except for repairs. The upper end of the cup-shaped disk has a peripheral flange and the lower ends of the punch die and solid disk are reduced so as to fit within the flange and accurately center said die and disk.

Beneath the cup shaped disk 22 and within the cylindrical support 23 is a hydraulic lift of peculiar construction which I shall now describe. The piston 25 of the lift is stationary and supported by a hollow piston rod 26 which rests upon the anvil block. The piston and rod may be integral and the opening in the piston rod extends from the upper side of the piston nearly to the lower end of the rod and at its lower end it is connected with a pipe 27 which conveys water or oil under pressure to operate the lift. The piston follower 27 is screwed into a threaded recess in the upper surface of the piston, and a packing ring of asbestos 30 is confined between the flange 28 and the piston proper. I prefer to use asbestos for the reason that other materials suitable for packing soon become burned out and useless. Fitting loosely within the cylindrical support 23 and surrounding the piston is a cylinder 31 closed at its upper end. Upon the lower end of the cylinder is a nut 32 screwed or otherwise attached thereto having an inwardly projecting flange or shoulder 33 adapted to engage the under side of the piston when the cylinder is forced upward and thus limit its motion and prevent it from being forced off of the piston. The cylinder at the lower end of its travel rests upon the follower 27. If the upper face of the follower were of the same diameter as the piston the hammering action of the latter would spread the nut and soon cause it to work tightly or prevent it working altogether in the cylinder. To obviate this I bevel or otherwise cut away the upper edge of the follower. As shown a rectangular portion is cut away thus leaving the flange 28. After the wheel center is forged with a solid hub as shown in Fig. 4 the upper die is raised and the wheel center and disks 21 and 22 afterward elevated by means of the hydraulic lift. The wheel is then sustained temporarily and moved to one side by a suspended forked lever, handled by workmen, while a punch die 35 is substituted for the solid disk 21. The wheel center is then replaced in the matrix and a punch 36 placed upon the depression formed by the projection 15. The punch 36 has upon its upper end a cylindrical projection 50 and a surrounding shoul-

der 51. The punch die 35 is cylindrical outside and its inner opening is tapered and slightly larger at the bottom than at the top. When in place it rests upon the cup-shaped disk 22 in the same manner as the solid disk 21. The punch is also tapered being slightly larger at the lower end than at the upper end. A head 37 has a recess in its under surface which fits upon the cylindrical projection 50 of the punch and a flange 52 surrounding the recess and adapted to register with the shoulder 51. The projection 50 and the corresponding recess in the head serve to center the punch and punch head and to prevent the punch from spreading under the impact of the die. The upper surface of the head is formed with a depression 38 in which the teat or projection 15 fits.

In order to prevent the piston from striking and injuring the upper cylinder head 40 the following devices are employed. In the head is formed an opening 41 having a valve seat which is covered by a valve 42 having a stem 43 projecting into the cylinder to such an extent that the piston comes in contact with it just as it passes and closes the upper steam port 2. Above the valve is a chamber 44 which is constantly supplied with steam under pressure through a pipe 45. As shown the stem of the valve is provided with ribs 46 which fit the cylindrical opening in the cylinder head and form guides therefor. The valve is normally held to its seat by the pressure of the steam in the chamber 44. A spring 47 bearing upon the valve may be added for additional security if desired.

The lower cylinder head and stuffing box are cast integral with the cylinder. In order to keep the water of condensation in the lower end of the cylinder away from the piston packing I provide a circular groove 51 in the upper face of the cylinder head 52, and a drip passage 53 leading to a drip pipe 54.

The operation of the machine is as follows: A billet of metal suitably heated is placed upon the lower die within the matrix, the solid disk 21 being in place as shown in Fig. 4, and the upper die is brought down with suitable force one or more times until the wheel center is formed as shown in said figure. The upper die is then lifted and the wheel center and the disks 21 and 22 raised by means of the hydraulic lift. The wheel center is then temporarily sustained and moved to one side by a suspended forked lever or other suitable device while the punch die 35 is substituted for the solid disk 21. The wheel center is then placed upon the punch die and lowered into the matrix, the punch die sinking into the well as shown in Fig. 6. The larger end of the punch is then placed in the recess formed by the projection 15 of the upper die and the said die moved carefully down until it rests upon the head 37, the projection 15 fitting in the recess in said head. A light pressure of the upper die sets the wheel cen-

ter and the punch firmly and correctly in place after which the upper die is brought down several times with considerable force thus driving the punch through the hub as shown in Fig. 7. The punching 39 is forced through into the punch die and sometimes partly into the cup shaped disk 22. The upper die is then raised, and wheel center lifted out of the matrix and carried to one side temporarily upon the forked lever as above described. When the wheel center is raised the punch drops out owing to its tapered construction. The punch die 35 together with the punching 39 are then removed and the solid disk 21 placed upon the disk 22. The hydraulic lift is then lowered, the wheel center replaced in the matrix, and a cylindrical block 50 slightly shorter than the thickness of the hub is placed within the central opening as shown in Fig. 8. The upper die is then again brought down to correct any distortion of the forging due to the punching operation. The punch die is again substituted for the solid disk and the block 50 forced into it by a smaller punch, which completes the operations. The forging is then removed from the matrix by means of the hydraulic lift and the forked lever as before described and a new billet substituted. The entire cycle of operations above outlined occupy but a few minutes and they are performed while the metal retains sufficient heat for forging so that no reheating is necessary after the billet is placed in the machine.

The operation of the safety device at the upper end of the cylinder is as follows: Steam is constantly admitted to the chamber 44 above the valve 42. Ordinarily the piston does not rise high enough to raise the valve. But if for any reason, such as carelessness on the part of the operator, the piston should rise above the port 2 the valve 42 would be opened and steam admitted to prevent the piston from striking the piston head. The under surface of the piston is reduced by the section of the large piston, and therefore the effect of the steam above is much greater than underneath and the piston is easily stopped.

Without limiting myself to the precise construction and arrangement of parts shown and described, I claim—

1. The combination in a forging machine with the main frame, of a cylinder supported by the frame, an enlarged piston rod forming the weight necessary for striking the blow, said piston rod having a comparatively light piston and tup attached thereto, and guideways upon the main frame constructed to guide the tup during its entire stroke, substantially as described.

2. The combination in a forging machine with the main frame, and an anvil, of an enlarged piston rod forming the weight necessary for striking the blow, a comparatively light piston and tup upon said rod, guideways upon the main frame for guiding the tup throughout its stroke, and a pair of dies, one

of said dies being connected to the tup and the other to the anvil, substantially as described.

3. The combination in a machine for forging, of a lower die, an upper die having a projection adapted to produce a depression in the forging for centering a punch, a tapered punch having its larger end constructed to fit said depression, and a separable head for the punch having a similar depression to receive the projection on the die, said die being thus adapted for use as a hammer for the punch, substantially as described.

4. In a machine for forging, the combination with the upper die and with a punch, of the lower die provided with an interchangeable punch die and solid disk, substantially as described.

5. In a machine for forging the combination with the upper die having a projection 15, and with the punch, of the lower die having a well and the interchangeable punch die and solid disk, both adapted to fit within the well, substantially as described.

6. In a machine for forging the combination with the lower die having a well, of a hydraulic lift in the lower part of the well, the interchangeable punch die and solid disk fitting within the upper part of the well, and a suitable support for said die and disk, substantially as described.

7. The combination with the lower die having a well, of the cup shaped disk arranged upon a suitable support within the well and having a peripheral flange at its upper edge, and the interchangeable punch die and solid disk having their lower ends reduced to fit within the flange of the cup-shaped disk, substantially as described.

8. The combination of the upper die, the punch having a cylindrical projection 50 and a shoulder upon its upper end, and the punch head having a recess on its lower side adapted to fit upon the projection and a flange fitting upon the shoulder of the punch, substantially as described.

9. The combination of the upper die having a projection, the punch having a head into which said projection fits, the lower die

having a well, the punch die within the well and having a tapered opening, the cup shaped disk below the punch die, and a suitable support for said disk, substantially as described.

10. In a forging machine the combination of the lower die having a well, and a hydraulic lift consisting of a movable cylinder fitting loosely in the well, and a stationary hollow piston and piston rod resting upon the anvil, substantially as described.

11. In a forging machine the combination with the lower die having a well and a hydraulic lift in said well surrounded by a cylindrical support of the cup-shaped disk resting upon said support, and the interchangeable punch die and solid disk, each adapted to fit within the well and to be centered upon the cup shaped disk, substantially as described.

12. In a forging machine the combination with the lower die having a well of the cylindrical base and support 23, 24, at the bottom of the well, and the hydraulic lift consisting of a movable cylinder fitting loosely within said base and support, and a stationary hollow piston and piston rod within the cylinder and resting upon the anvil, substantially as described.

13. In a forging machine the combination with the die having a well, of a hydraulic lift within the well consisting of a hollow piston rod resting upon the anvil of the die, a piston at the upper end of the piston rod, a follower upon the upper side of the piston having a reduced end to receive the blows of the cylinder, an asbestos packing ring between the follower and the piston, a movable cylinder surrounding the piston and closed at its upper end, and an inwardly projecting flange or shoulder at the lower end of the cylinder, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM A. PEARSON.

Witnesses:

J. A. WATSON,
WM. E. NEFF.