(No Model.) 6 Sheets—Sheet 1.

F. HESSENBRUCH.

HYDRAULIC MACHINE.

No. 535,586. Patented Mar. 12, 1895.

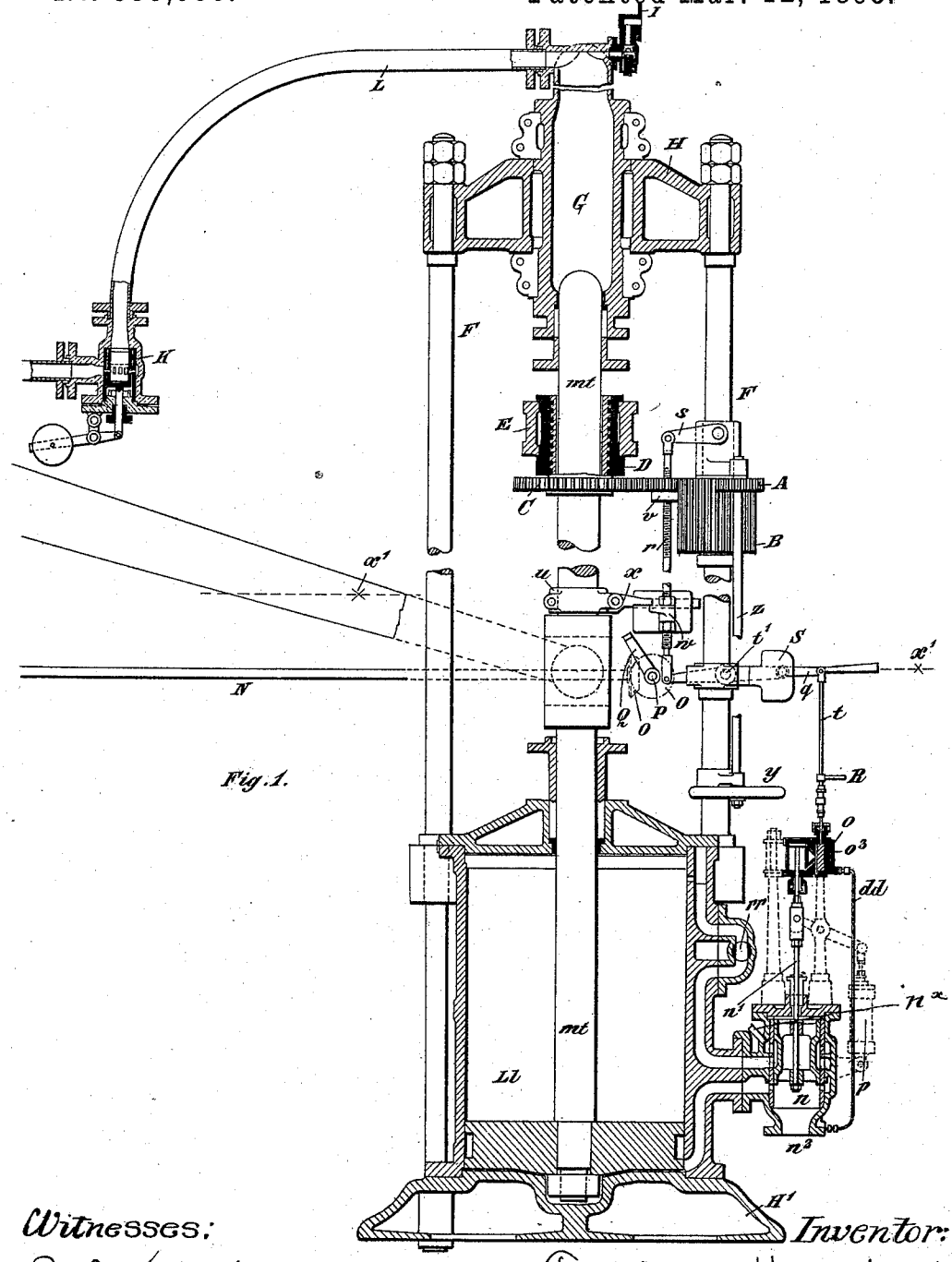


Fig. 1.

Witnesses:
J. D. Knigsbury.
G. A. Taubenschmidt,

Inventor:
Friedrich Hessenbruch
By Whittaker & Prevost Attys.

(No Model.) 6 Sheets—Sheet 2.

F. HESSENBRUCH.

HYDRAULIC MACHINE.

No. 535,586. Patented Mar. 12, 1895.

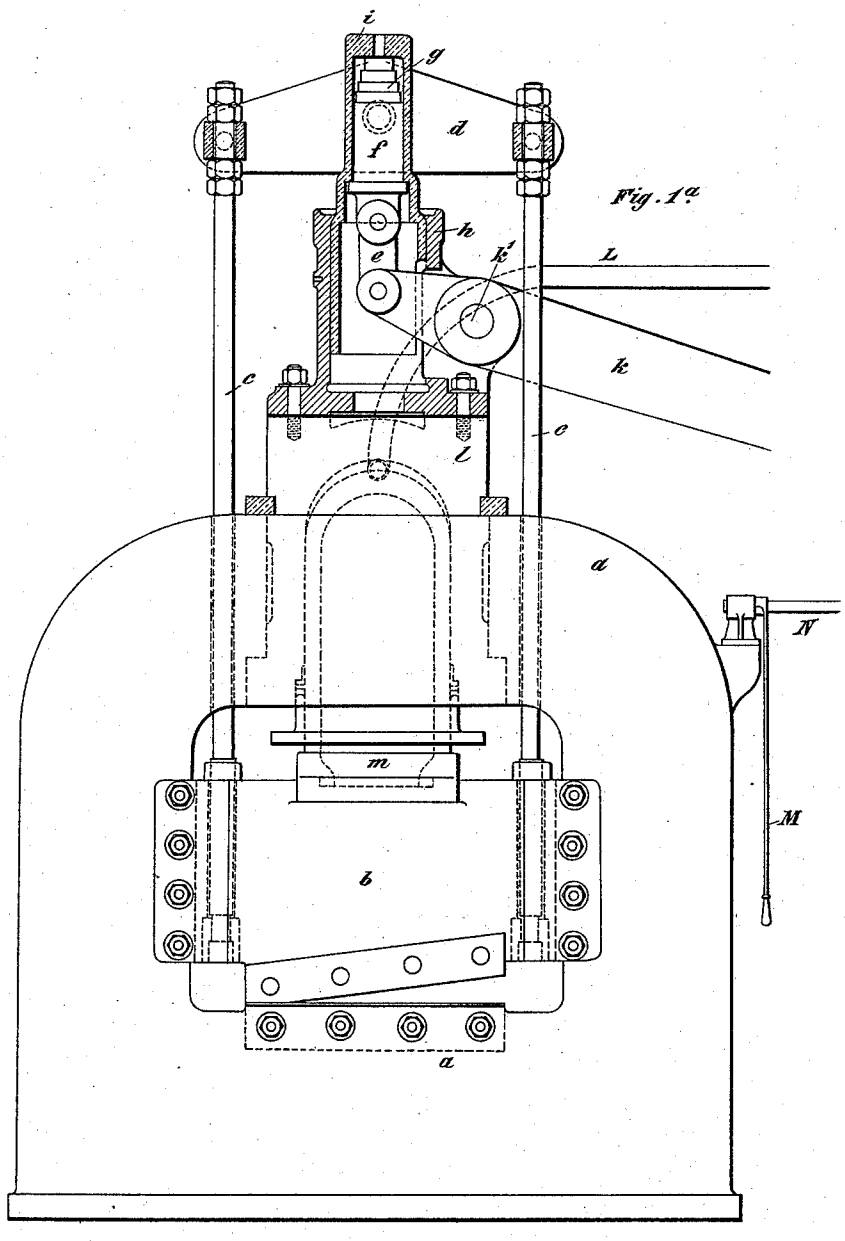


Fig. 1a

Witnesses:
J. D. Kingsbury
G. A. Tauberschmidt,

Inventor:
Friedrich Hessenbruch
By Whitaker & Prevost Attys.

(No Model.) 6 Sheets—Sheet 3.

F. HESSENBRUCH.

HYDRAULIC MACHINE.

No. 535,586. Patented Mar. 12, 1895.

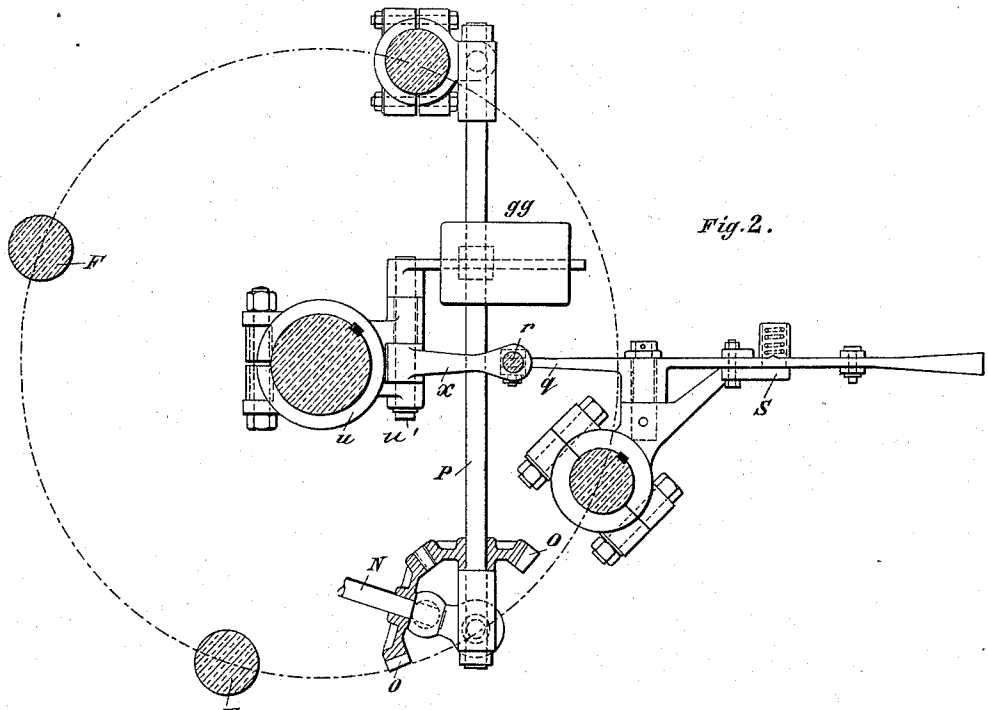


Fig. 2.

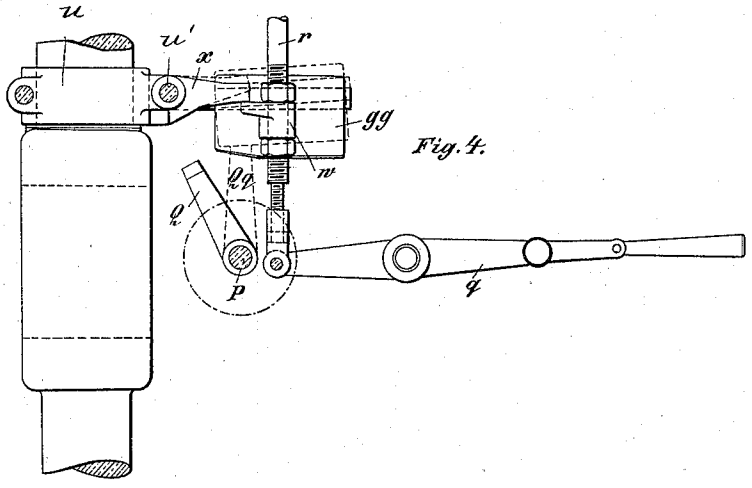


Fig. 4.

Witnesses:
J. D. Kingsbury.
G. A. Waubenschmidt.

Inventor:
Friedrich Hessenbruch
By Whitaker & Prevost attys.

(No Model.)

6 Sheets—Sheet 4.

F. HESSENBRUCH.

HYDRAULIC MACHINE.

No. 535,586. Patented Mar. 12, 1895.

Fig. 5.

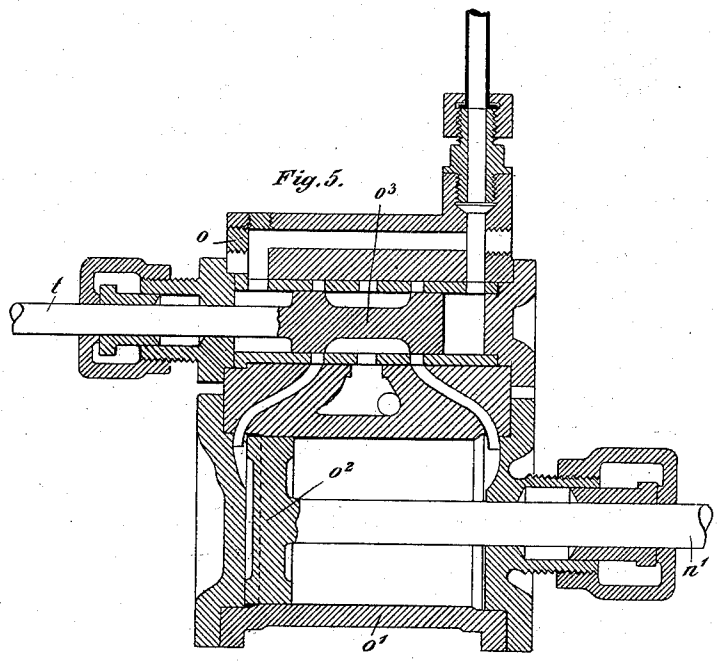
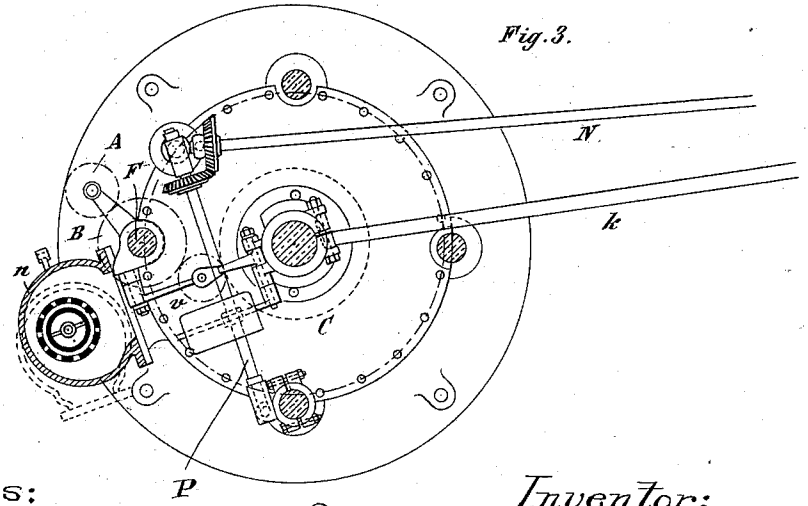


Fig. 3.



Witnesses:

J. D. Kingsbury.

G. A. Lauberschmidt.

Inventor:

Friedrich Hessenbruch

By Whittemore & Prevost Attys.

(No Model.)

6 Sheets—Sheet 5.

F. HESSENBRUCH.

HYDRAULIC MACHINE.

No. 535,586. Patented Mar. 12, 1895.

Fig. 6.

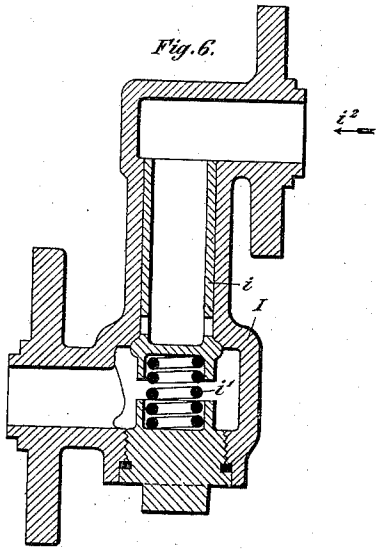


Fig. 7.

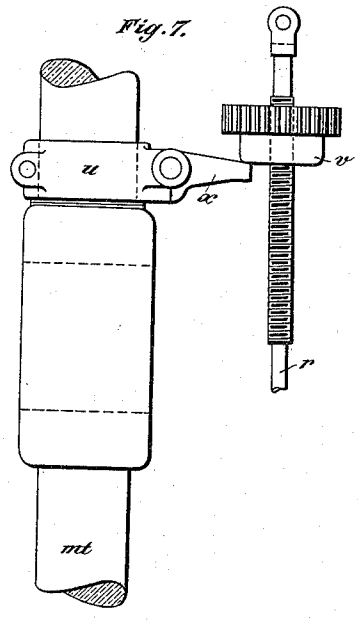


Fig. 8.

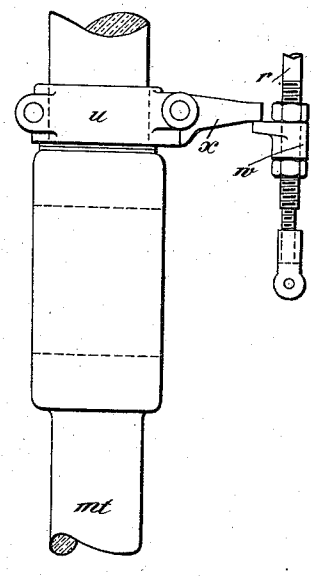
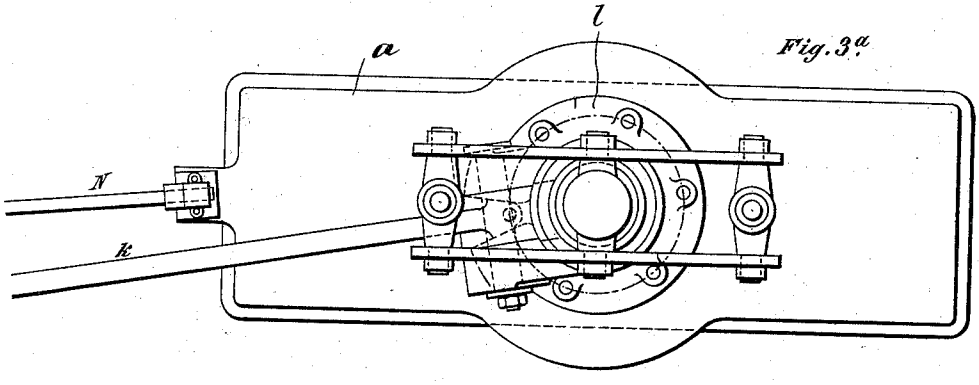


Fig. 3ª.



Witnesses:

J. A. Kingsbery.

G. A. Taubenschmidt.

Inventor:

Friedrich Hessenbruch

By Whitaker & Prevost Attys

(No Model.) 6 Sheets—Sheet 6.

F. HESSENBRUCH.

HYDRAULIC MACHINE.

No. 535,586. Patented Mar. 12, 1895.

Fig. 9.

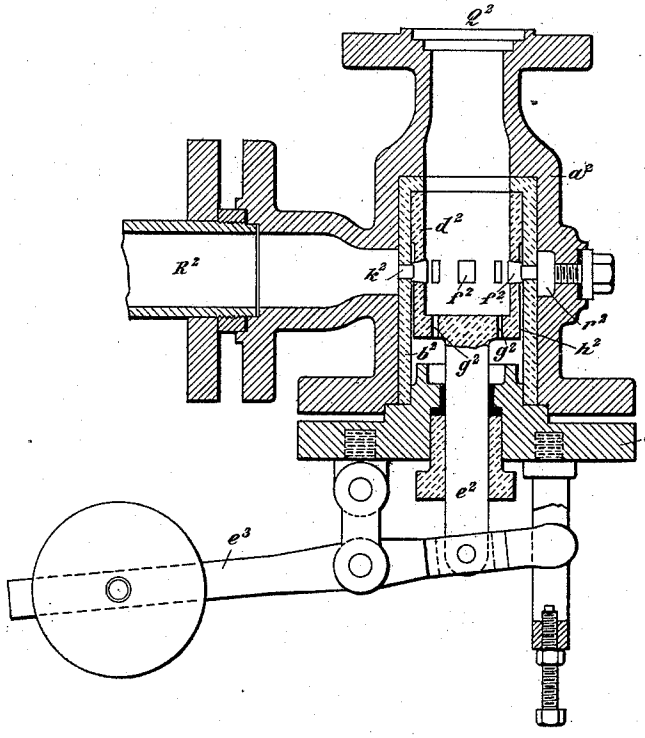


Fig. 10.

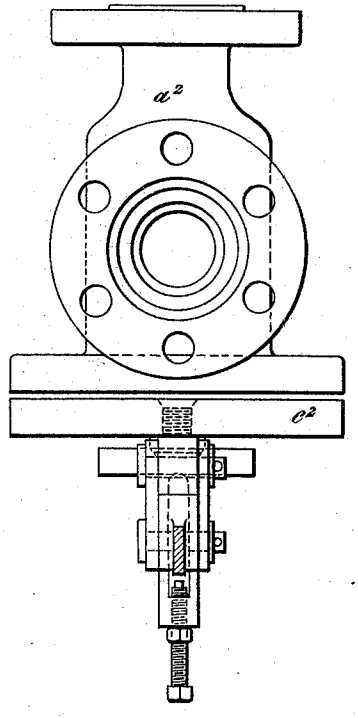


Fig. 11.

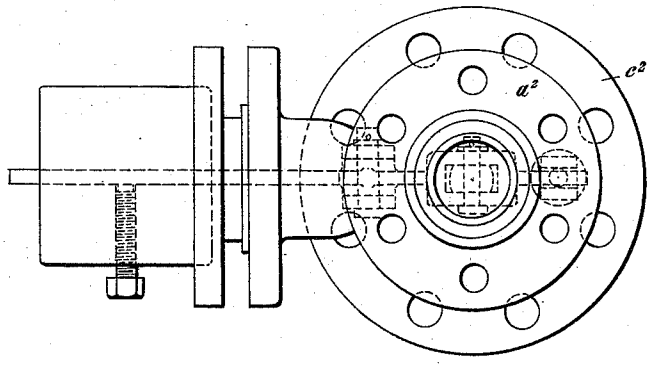
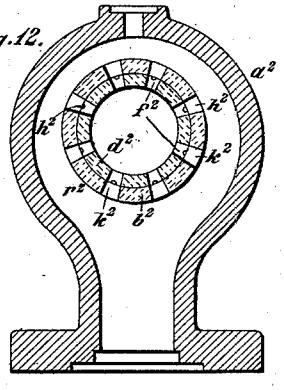


Fig. 12.



Witnesses:

J. O. Kingsbury.

G. A. Barberschmidt,

Inventor:

Friedrich Hessenbruch

By Whitaker & Prevost Attys.

UNITED STATES PATENT OFFICE.

FRIEDRICH HESSENBRUCH, OF DUISBURG, GERMANY.

HYDRAULIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 535,586, dated March 12, 1895.

Application filed May 23, 1894. Serial No. 512,220. (No model.)

To all whom it may concern:

Be it known that I, FRIEDRICH HESSENBRUCH, director of a public company, residing at Duisburg, in the Kingdom of Prussia and German Empire, have invented new and useful Improvements in Hydraulic Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

The subject of this invention is a machine for working wood or metal in which the working stroke is obtained indirect from the pressure of steam by hydraulic means, when the return of the parts is effected exclusively by mechanical means operated only by the waste steam. This principle is shown as an example of carrying out the same in the accompanying drawings as shears, in which the movable shearing knife is attached to a movable plunger, which for the working stroke and return slides in a fixed press cylinder. The position at the commencement viz: that of rest, is always the same, but the extent of the working stroke may always be varied by the automatic control of the machine, or the automatic control may be changed to hand control in which case the extent and duration of each stroke can be regulated at will. The governor influences the stroke of a piston moved by steam power, which piston is used to obtain the necessary compression of the liquid or water in a cylindrical accumulator.

In order that my invention may be the better understood I now proceed to describe the same with reference to the accompanying drawings and to the letters of reference marked thereon.

Figures 1 and 1ª are sections through the apparatus. Fig. 2 is a transverse section through the line x' x', Fig. 1. Figs. 3 and 3ª are plans of Figs. 1 and 1ª with partial section through the multiplicator. Fig. 4 is a detail view of the device for disengaging the governor. Fig. 5 is a detail view of the valve operating piston. Fig. 6 is a detail view of the water suction valve. Fig. 7 is a detail view of the device for operating the reverse governor when the plunger carrying the movable shearing knife has finished its stroke and returns. Fig. 8 is a detail view of the device for operating such reverse governor when the plunger carrying the shearing knife commences its work. Fig. 9 is a vertical sectional view of the regulating valve interposed between the accumulator and the plunger of the tool showing a portion of the pipe communicating with said plunger. Fig. 10 is a side elevation of the said valve taken from the left in Fig. 9 showing the weighted lever in section. Fig. 11 is a top plan view of the valve as shown in Fig. 9, and Fig. 12 is a horizontal sectional view through the valve casing and valve proper. All detail views are enlarged as compared with the principal view.

Into the standard *a* of the shearing device, Figs. 1ª and 3, is fixed the pressure cylinder *l* in which slides the movable plunger *m*, Fig. 1ª. To the latter is fixed the movable shearing knife *b*, which is guided during the operation upward and downward in the standard *a*.

The pressure cylinder *l* is connected with an accumulator G by means of pipes L L. The accumulator G is fitted into a transverse piece H which is connected to the base plate H′ by means of four columns, Fig. 2. To the base plate H′ is also fixed the steam cylinder L *l* in which moves up and down a piston and piston rod *m*, *t*. The elongated piston rod *m*, *t*, reaches into the before mentioned accumulator G and forms here the pressure plunger.

The spaces in the accumulator G, the pipes and pressure cylinder *l* are filled with water or any other suitable fluid, so that the lift of the piston moving in the cylinder *l* operates the plunger carrying the shearing knife *b*.

Two draw bars *c* are attached to the movable knife *b*, and carry at their ends the transverse piece *d*. To the latter is attached a pot *i* moving upward and downward with the knife and guided in the guiding piece *h* of the fixed hydraulic cylinder *l*. On the upper bottom of the pot *i* rests a volute spring *g* which constantly endeavors to depress, by means of a guiding cylinder *f* and a connecting rod *e*, the short end of a lever *k* pivotable around the pin *k*′ on *h*. The other, longer end of the lever *k* engages with the piston rod *m t*. In consequence the lever *k* joins in the up and down movement of the piston sliding in L *l* and also the working stroke of the movable shearing knife *b*. The diameters, and consequently the travel of the plunger *m t* reaching into G and of the plunger *m* are different. The lengths of the arms of the

lever k are therefore chosen so that they are in a reverse proportion to the surfaces of the plungers m—t, and m.

When the piston L l ascends, the plunger m t compresses the fluid in the accumulator G and b makes its working stroke. However, in consequence of the leakage of the service pipes and joints, part of the fluid is lost. Therefore the stroke is smaller than it should be theoretically. If the connection between b and the shorter arm of k were rigid, the transmission of movement would also, during the working stroke of b, be not by hydraulic means, but by the lever k. In order to avoid this possibility, the volute spring g is inserted between i and f and is always in tension. If the working travel of the plunger m becomes smaller by loss of power than it should be theoretically the spring will expand somewhat, but the completion of the working stroke of b will always be transmitted by hydraulic means from L l to t m.

It is necessary for the continuous working of the machine to lead the steam alternately over and under the piston moving in L l. For this purpose the machine is provided with an automatic governor or reversing apparatus. Steam channels lead to both ends of the cylinder L l joining each other and entering the box n. In this box moves a circular valve of known construction which is operated by a steam relay valve apparatus o and the rod n', so as to open, at its highest position, the lower cylinder steam port for the fresh steam entering at n^2, while the upper steam port of the cylinder L l is connected to the atmosphere as indicated at $n^\times$. At its lowest position the circular valve connects the upper with the lower cylinder steam port so that the steam which has previously entered below the piston and at high pressure passes above the piston and causes the latter to descend. The apparatus o, Fig. 1, which moves the before mentioned circular valve up and down, is shown in detail in Fig. 5 and consists of a cylinder o', a piston o^2 moving in it, and a control valve o^3. The latter is connected to a hand lever g, pivoted at t', by means of a rod t. The said lever carries the governor spindle r. The latter is screw threaded and provided with the projection w, and with the cog wheel v a certain distance therefrom. To the piston rod m t is fixed the ring u, also shown in Fig. 2, on which is pivotally mounted a pin u', having a lug x and a lever carrying weights g g. The lug x has a tooth, Fig. 4, which is caused by the weights g g to butt against a projection on the ring u, so that x always remains horizontal and can only be turned upward after overcoming the weights g g.

When the piston, sliding in L l Fig. 1, descends, it strikes the projection w, Fig. 3. The weights g g, Fig. 4, are attached to the lever carrying them, in such a manner as to produce sufficient momentum to carry the governor spindle r, with them downward whereby the valve o^3 is placed in its highest position and the steam enters below the piston o^2 of the steam valve relay apparatus, Fig. 5. The circular valve is thereby returned into its highest position n. The fresh working steam can now enter into L l below the piston, thus effecting a rise of the latter. Before the piston reaches its highest position in L l, the lug x strikes against the cog wheel v and as it cannot move downward it lifts the latter and the governor spindle r and lowers the valve o^3 by means of q and t, so that the circular valve reaches its lowest position at n, thus connecting the space below the piston in L' l with the space above it, which would cause the lowering of the whole mechanism while the lowering plunger m would return upwards into its original position.

In order to insure that the movement of the circular valve sliding in u upward and downward, or vice versa, shall not be too rapid, an oil brake cataract p is provided which is connected with the valve rod n' by means of a lever.

As before mentioned, the working stroke of the plunger m, *i. e.*, the movement downward, is effected by water under pressure through the movement of the piston driven upward in L l by steam. However, when m has arrived at the end of its working stroke and the piston descends again in L l m must return upward. This is effected by means of the lever k, the water, pressed toward l being again pressed backward toward G by the plunger moved into l. Thus the return of the plunger into its its original position is effected by mechanical means in this case the lever k operated by steam.

At the continuous working of the shears, the movement of the machine might be occasionally too quick, because there may not always be dynamic equilibrium between the motor (in this case L l) and the shears. Therefore for the regulation of the operative velocity, a regulating valve k is inserted into the water pressure pipe, Fig. 1, shown in an enlarged scale in Figs. 9 to 12.

Into the valve casing a^2, Figs. 9 and 12, is inserted the sleeve b^2, having a number of perforations k^2. In the sleeve b^2 moves a pot d^2, also provided with perforations f^2. The perforations f^2 correspond with those k^2 when d^2 is in its highest position. On the outer circumference of d^2 are grooves corresponding to the number of holes f^2 through which they pass. The bottom of the pot has small orifices g^2 and the pot itself is connected by a spindle e^2 to the weighted lever e^3. The fluid passing through from G, presses against the bottom of the pot d^2 and, according to the position of the weight e^3, the position of the orifices k^2 and f^2 is such that the fluid at its passage therethrough receives at one time a large amount of resistance and at another a less amount of resistance. If d^2 is lowered in consequence of excessive velocity, the passage from k^2 to f^2 becomes narrower by de-

grees until they are entirely removed from one another. Then remains only the passage through g^2 and h^2 to k^2 for the liquid. The resistance caused thereby reduces the operative velocity.

When the plunger m, Fig. 1, makes its return journey, there is no pressure over d^2. In consequence the weight resting on e^3, Fig. 9, moves the pot d^2 into the position shown in Fig. 9, so that the perforations f^2 and k^2 come into one plane, thus leaving a free passage for the fluid driven back. Further, to counteract the loss of fluid produced by leakage a suction valve I, Fig. 1, is inserted into the service pipe L. It consists of a tubular valve i, Fig. 6, which is pressed against its seating by the pressure existing in the service pipe L during the piston stroke. The losses by leakage occur during this period. When the plunger m, Fig. 1, returns into its normal position, the fluid pressure in L becomes less in consequence of the loss by the leakage, so that the tubular valve i descends from its seating and fluid is allowed to enter from i to the same amount as had been lost previously. If equilibrium of pressure has been established between L and i^2, the spring i' presses the tubular valve back to its seating.

The foregoing shows that the working plunger m, Fig. 1, always executes an equal stroke from its original position. However, this is sometimes not desired. If a short stroke is sufficient, a large stroke means loss of time and power. In order to allow of the adjustment of the stroke, a cog wheel B is journaled on one of the pillars F, Figs. 1 and 3, which engages with a cog wheel v and is operated by a pinion A, axle z and hand wheel y. A cog wheel C journaled on $m\ t$ engages with the cog wheel v on the governor spindle r and is screw threaded on its elongated boss. The latter is screwed into a nut D fixed to the transverse piece E. The pitch of the threads of C and v are in reverse proportion to the diameters of their pitch circles. Both screws are threaded oppositely. In consequence the wheels C and v remain always engaged. For this purpose the width of tooth of B is sufficiently large.

At the rotation of y, v and C are screwed either farther up or farther down according to the direction of rotation. In consequence, the lug x strikes v and reverses the position of the control valve o^3, thus reversing the movement of the piston $m\ t$. The cog wheel C in this case forms a limit to the stroke by the ring u on the piston rod striking against C. Thus the extent of the working stroke of m may be varied in accordance with a different normal position of starting.

If the working is not intended to be continuous, but if the working strokes are intended to follow each other at irregular intervals, the lever M, Fig. 1^a, is turned upward, which movement is transmitted to the shaft P, by means of the shaft N, also Fig. 2, and the bevel wheels O O.

The shaft P carries an arm Q, which is brought into the position shown in dotted lines, in Fig. 4, by the rotation of the axle and turns the counter weights $g\ g$ and the lug x upward at the continued downward movement of $m\ t$ so that the lug x cannot act upon w and is not reversed until reversal is effected by hand through the handle of the lever g. Therefore in this manner the normal position may be changed to a higher place, as may sometimes be desired.

If M is again turned downward, as shown in Fig. 1^a, the lever q returns also into its original position so that the weights $g\ g$ act also upon w.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In a hydraulic machine tool the combination with a hydraulic press carrying a tool, of a steam cylinder and piston, a hydraulic accumulator operatively connected therewith and connected with said press for producing the working stroke of the tool and a positive mechanical connection between said piston and the tool for returning said tool by steam pressure in said cylinder, substantially as described.

2. In a hydraulic machine tool the combination with a hydraulic press carrying a tool, of a steam cylinder and piston, a hydraulic accumulator operatively connected with said piston and connected with said press for producing the working stroke of the tool and a lever for returning said tool connected with said piston and having a yielding connection with said tool, substantially as described.

3. In a hydraulic machine tool, the combination with a hydraulic press carrying a tool, of a steam cylinder and piston, an accumulator operated by said piston and connected with said press, a pivoted lever for returning said tool having one end operatively connected with said piston and the other end operatively connected with said tool and a spring interposed between said tool and said lever, substantially as described.

4. In a hydraulic machine tool the combination with the hydraulic press carrying a tool, and the accumulator therefor, of a steam cylinder and piston for operating said accumulator to produce the working stroke of said tool, an operating lever connecting said tool with said piston to produce the return movement of said tool, said lever being connected to said tool to move the same positively in a return direction and having a yielding connection therewith when moving in the opposite direction, substantially as described.

5. In a hydraulic machine tool, the combination with the hydraulic press carrying the tool, of an accumulator for said press and a steam cylinder and piston for operating said accumulator, devices for adjusting the stroke of said accumulator and tool and adjustable devices for positively limiting the stroke of said accumulator, substantially as described.

6. In a hydraulic machine tool the combi-

nation with the hydraulic press carrying the tool, of an accumulator for said press, a steam cylinder and piston for operating said accumulator, a governor rod for controlling said cylinder, an arm connected with said piston reversing devices on said rod located in position to be engaged by said arm to reverse the piston, accumulator and tool, a rigid abutment for limiting the movement of said piston and devices for adjusting said abutment and the reversing devices on said governor rod, substantially as described.

7. In a hydraulic tool the combination with the hydraulic press carrying the tool, the accumulator therefor, and the steam cylinder and piston for operating said accumulator, of the governing rod for controlling said piston having a hand operating lever connected therewith, said rod having reversing devices, an arm connected with said piston for engaging said reversing devices and means for moving said arm out of position to be engaged by said reversing devices, to enable the tool to be controlled by said hand lever, substantially as described.

8. In a hydraulic tool the combination with the hydraulic press carrying the tool, of the accumulator therefor and the steam cylinder and piston for operating said accumulator, of the governor rod for reversing said cylinder provided with projections, a pivoted operating device connected with said piston for engaging said projections, weights for holding said device in operative position, and a device adapted to be moved into the path of said weights to remove said pivoted operating device out of position to engage one of the said reversing projections, substantially as described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

FRIEDRICH HESSENBRUCH.

Witnesses:
WM. ESSENWEIN,
ALBERT LIEBER.