Feb. 8, 1927. 1,616,856

C. L. HUSTON

SIMULTANEOUS INTENSIFIER FEED FOR SEPARATE SHEARS

Filed July 24, 1922 3 Sheets-Sheet 1

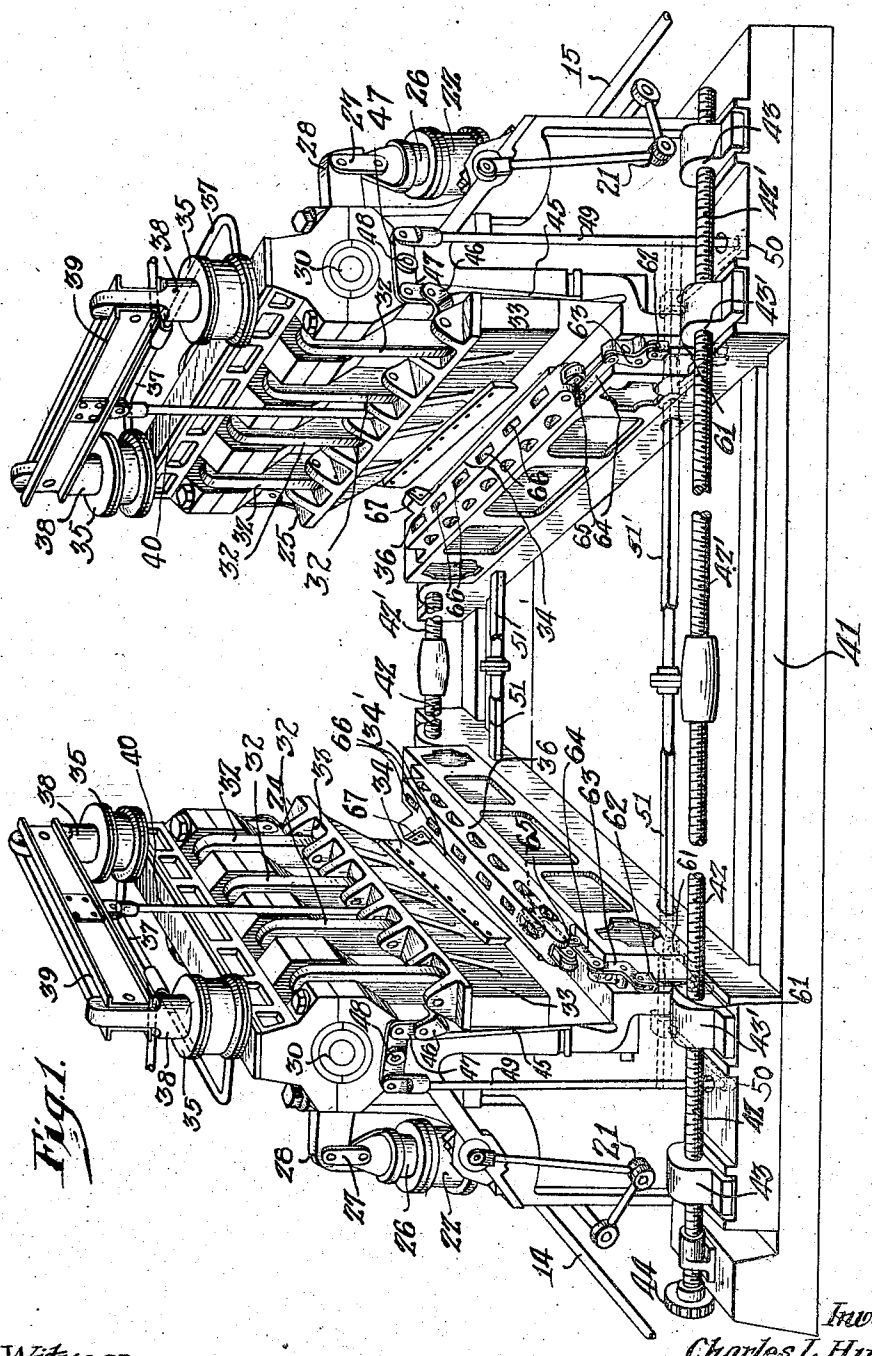


Fig. 1.

Witness:
Walter Chism

Inventor:
Charles L. Huston.
by [signature]
Attorney.

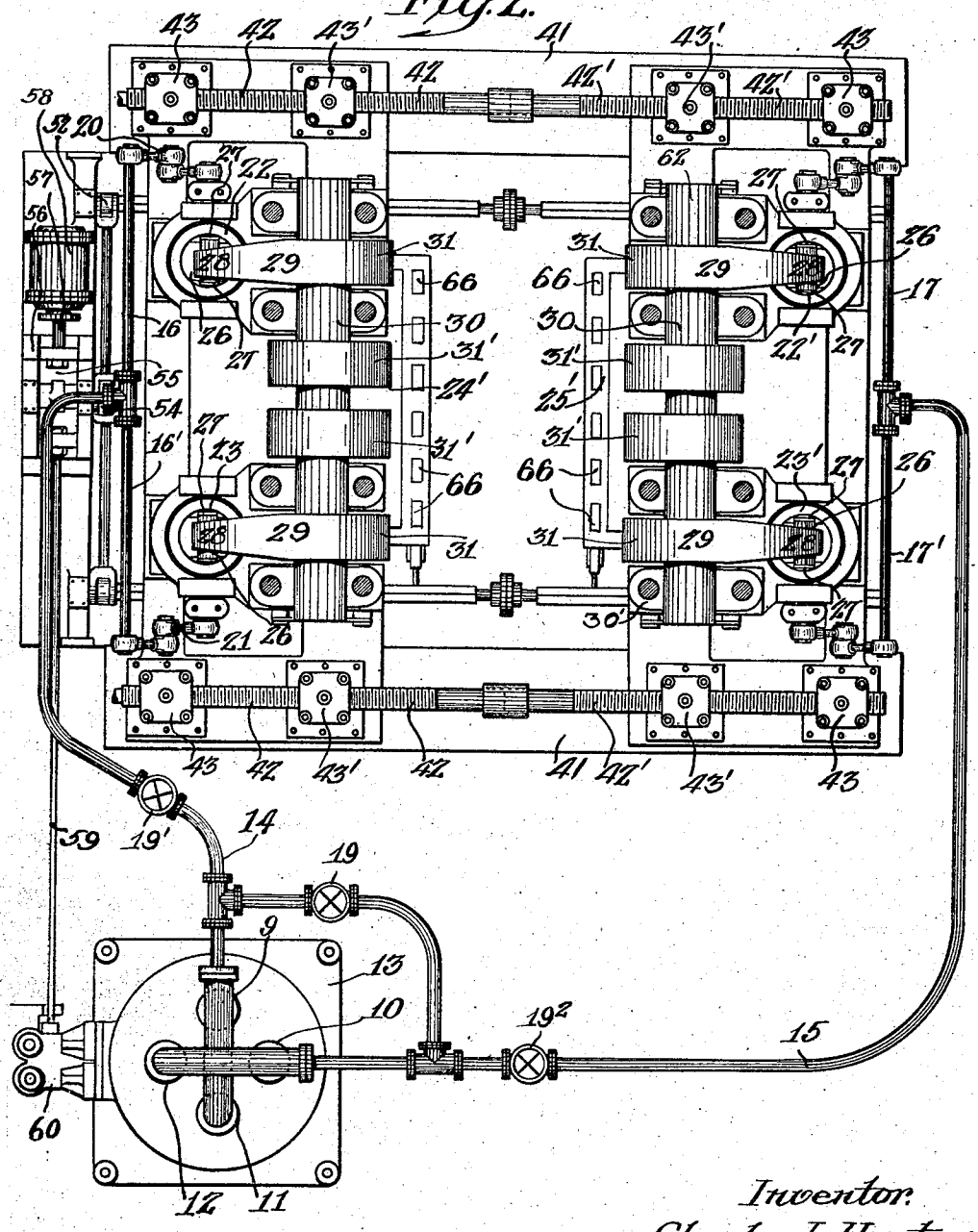
Feb. 8, 1927. 1,616,856

C. L. HUSTON

SIMULTANEOUS INTENSIFIER FEED FOR SEPARATE SHEARS

Filed July 24, 1922 3 Sheets-Sheet 2

Fig. 2.



Witness:
Walter Chism

Inventor:
Charles L. Huston
by C. L. Steele Jackson
Attorney.

Feb. 8, 1927. 1,616,856

C. L. HUSTON

SIMULTANEOUS INTENSIFIER FEED FOR SEPARATE SHEARS

Filed July 24, 1922 3 Sheets-Sheet 3

Fig. 3.

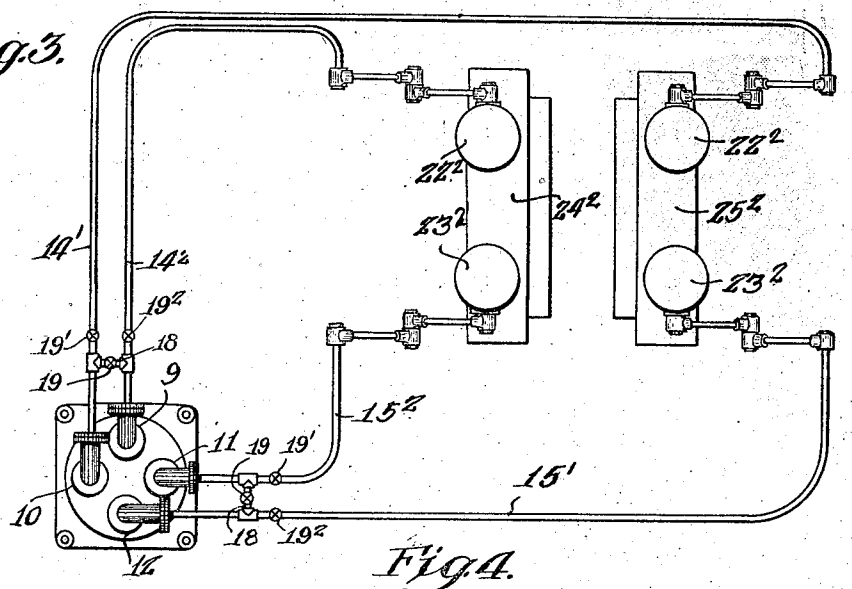


Fig. 4.

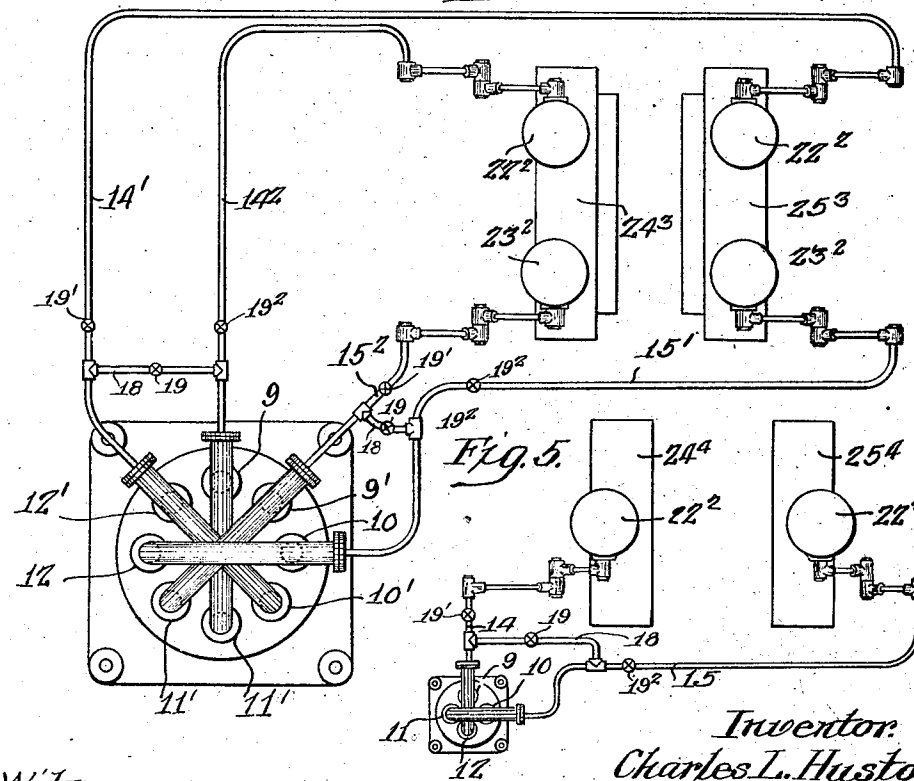


Fig. 5.

Witness:
Walter Chism

Inventor:
Charles L. Huston.
by C. Steell Jackson
Attorney

Patented Feb. 8, 1927. 1,616,856

UNITED STATES PATENT OFFICE.

CHARLES L. HUSTON, OF COATESVILLE, PENNSYLVANIA.

SIMULTANEOUS INTENSIFIER FEED FOR SEPARATE SHEARS.

Application filed July 24, 1922. Serial No. 576,999.

My invention relates to the hydraulic operation concurrently of two or more shears upon heavy sheet material.

The purpose of my invention is to synchronize the movements in the shears operated, throughout the range of effective operation.

A further purpose is to maintain equal hydraulic pressures and equal rates and quantities of hydraulic flow upon the rams of the several cylinders used.

A further purpose is to supply different shears from separate high pressure cylinders of the same intensifier, preferably grouped in pairs across the intensifier axis, synchronizing the cylinders of the same shear, where more than one cylinder is used, by the same means of separate intensifier cylinder supply or mechanically as best suits the conditions of the case.

Further purposes will appear in the specification and in the claims.

My invention relates to the processes involved and also to mechanism by which these processes may be carried out.

I have preferred to illustrate my invention by a few simple diagrammatic forms only for the hydraulic connections, in conjunction with further detail as to a pair of shears to which the invention may be applied, selecting these forms because of their suitability for illustration of the principles of the hydraulic and mixed hydraulic and mechanical control invented by me.

Figure 1 is a perspective view showing a pair of opposed parallel shears to which my invention is applied.

Figure 2 is a section, largely comprising a top plan view of a pair of shears of the general character shown in Figure 1, omitting the pull back cylinders and bearing caps and adding diagrammatic intensifier connection for the main shear cylinders.

Figures 3 and 4 show, diagrammatically, a pair of opposed parallel shears having two cylinders each, supplied through different hydraulic connections.

Figure 5 shows diagrammatically a pair of single cylinder shears with hydraulic connections therefor.

In the drawings similar numerals indicate like parts.

Though my invention is applicable to synchronous operation of hydraulic shears having a single cylinder each or any plurality of cylinders each, or of hydraulic shears having a different number of cylinders, one having more than the other, I have preferred to select for my main illustration a pair of hydraulic shears having two main cylinders each and operating simultaneously upon the same plate, because the varying leverage met with by the plungers moving these shear blades present the most difficult problem for application of my invention. The individual plungers must be synchronized in each machine, as well as the two machines. In this form the control of the two plungers of the same machine is mechanical, though, as seen from Figures 3 and 4, they could be controlled hydraulically.

In Figure 2, the high pressure cylinders 9, 10, 11 and 12 of an intensifier shown diagrammatically at 13, are joined by pipes 14 and 15 with distributing pipes 16, 16′, 17, 17′. By-pass 18, is controlled by a valve 19, which is normally closed. When it is desired to operate either shear alone this valve is opened and valve 19′ or 19^2 is closed to cut off one or other of the shears. Obviously all three valves 19, 19′, 19^2 can be combined in a single structure for simultaneous operation or be operated by suitable combination of control mechanism to simplify or facilitate the accomplishment of the same object.

The distributing pipes connect through swivel joints 20, 21 with high pressure (main) operating cylinders 22 and 23, 22′ and 23′, in the two shears 24 and 25.

In each shear the plungers 26 of these several cylinders are connected by links 27 with the rear ends 28 of levers 29. These levers are keyed to a common shaft 30. The opposite ends 31 of these levers are connected by pitman 32 with the upper beam 33 carrying the upper shear blade 34. Two intermediate levers 31′, also keyed to the shaft, are connected to the upper beam through pitmen 32. The shaft is mounted in bearings 35.

The lower knife 34′ is secured to a fixed beam 36. The pull back cylinders 35 are constantly connected by pipe 37 with an accumulator (not shown) so that the fluid within the pull back cylinders flows from them into the accumulator with downward movement of the shear beam but the constant accumulator pressure lifts the plung-

ers 38 and beam 39 when the intensifier pressure is relieved from the operating cylinders. The connection with the movable beam 33 by link 40 completes the pull back connections for lifting the beam 33.

As thus far described the intensifier and fluid connections are intended to typify an intensifier connection by which high pressure liquid is delivered equally to two hydraulic shears without variation by reason of the different resistances met with by these shears in their movement; and it will be noted that the operation of each shear from a separate pair of high pressure cylinders ensures equalized fluid supply to the shears, whatever the number of shear cylinders. Moreover the grouping of the high pressure intensifier cylinders shown, connecting cylinders 9 and 11 across the axis of the main steam intensifier cylinder, and cylinders 10 and 12 across the axis for the supply of the second shear, balances the pressure hydraulically in the intensifier so as to avoid canting pressure upon the steam piston rod of the intensifier even if one shear only be overcoming resistance. It will be evident also that this same form of intensifier high pressure connection may be led through supply pipes 11 and 12 to any two hydraulic shears having a single cylinder each or cylinders maintained in synchronism by mechanical means, and the broad invention is independent of these differences in detail of application.

The machine shown in Figures 1 and 2, in so far as it has been described, is intended to be typical also of all hydraulic machines having a plurality of cylinders and in which the movement of the cylinders, plungers or rams is mechanically synchronized.

However, for the purpose of laying a foundation in this application for further applications upon inventions made by me I have shown a number of additional features in connection with these shears relating to the adjustment of the distance between the shears, the relief of the movable shear knife from the fixed shear knife during upward movement of the former, the lifting of the plate sheared free from the fixed shear knife after the cut, and a scrap-cutting knife used in connection with the heel or toe of the main knife, all of which are advantageous for use in connection with the hydraulic or hydraulic-mechanical synchronism of separate shears but are of advantage also in shears which are wholly independent in operation.

Though the shears intended for simultaneous operation may occupy any positions required by the work to be performed, and special work will require special placing, it is ordinarily desirable to mount the shears face to face, so that they can operate upon opposite sides or opposite ends of the same plate, and to adjust the distance between them. The two shears are so mounted upon a common bed 41 and are adjusted toward and from each other by right and left handed screws 42, 42′ operating in nuts 43, 43′ and turned by means of my gear 44 and shafting or other source of power not shown.

In order to provide for lateral release of the upper shear knives upon their upward strokes and at the same time to maintain proper engagement between the upper and lower knives upon the downward stroke, I displace the upper (movable) beams of the two shears laterally for the downward stroke from the planes in which they would move by gravity alone, by means of movable guides. These divert the upper shear knives into line with the respective lower shear knives. At the end of the shearing strokes I move the guides, permitting the upper beams to fall back from the lower beams for the upward strokes. I accomplish this by the use of wedges 45, whose front faces act as guides for the beams and which, in the lower wedge positions, maintain the upper knives in line to cooperate with the lower blade for the shearing function. In the upper wedge positions the wedges allow the beams and knives to fall away from the shearing plane. This relieves the movable knives from engagement with the fixed knives and with the work on the upward stroke.

Considering a single shear:—

The wedges are lifted by links 46 upon one end each of levers 47 pivoted at 48. The other ends of these levers are connected by rods 49 with levers 50 having sliding connection with oscillatory shafts 51, 51′. These shafts are squared so that the shafts can slide through the levers without losing this oscillatory connection when the shears are moved toward and from each other. The shafts are turned by lever arms 52 connecting with links 53 operated by a cam or projection at 54 upon a cross head 55. The cross-head is reciprocated in guides 56 by the piston rod 57 of a hand-controlled operating cylinder 58. The cross-head or piston rod is connected by rod 59 with valve 60 controlling steam admission and exhaust to and from the main intensifier cylinder.

The timing is such that the wedges are lifted automatically prior to the opening of the intensifier exhaust, and, hence, prior to the lifting of the upper beam by the rams of the pull back cylinders. On the reverse stroke the cam operation is so timed that the wedges are set before the steam valves are opened to apply intensifier pressure to the main tool cylinders. Two rods 51, 51′ are used in order to operate the wedges at the opposite ends of the two machines, and the connections between the shafts and the wedges are the same in all four positions.

One of the shafts which is rocked to lift

the wedges and allow them to lower, is connected at each machine with a bell crank 63, through lever 61, slidable upon but oscillating with the shaft, and a link 62 engaging the bell crank. The latter is connected by rod 64 with one end each of a series of bell cranks 65. The other ends of these bell cranks carry rollers 66 which thus engage and lift the plate cut at the same time that the wedges are lifted and prior to the upward stroke of the beam.

At the trailing ends of the main shear knives I place separate upper and lower cutting knives, placed at an angle to and connecting with the main cutting knives for the purpose of cutting off the scrap. The lower of these scrap cutting shear knives is shown at 67.

In operation:—So far as the synchronizing of the two shears, and the two ends of the same shear are concerned, the operation is extremely simple. Starting with the movable beams in their upper positions, movement of the piston of the control cylinder first causes the rollers 66 and wedges 45 to lower. The wedges force the upper beam out until its knife is in the shearing plane. As further movement of this control piston causes the steam valve of the intensifier to open, hydraulic intensifier pressure is admitted simultaneously and in equal quantity to the two shears. Except for the mechanical connection between the plungers, the water supplied to each shear in the forms of Figures 1 and 2 would be free to divide between its two cylinders, filling first that cylinder in which least resistance is met.

With the connection through the shaft, the rate of water input to the main cylinders of each individual shear is kept uniform and the control is a combination of hydraulic and mechanical control, being hydraulic in so far as the two shears are concerned and mechanical within the individual shears.

As the upper beam moves downwardly by reason of the intensifier pressure, the fluid within the pull back cylinders is forced back into the accumulator, from which it subsequently flows to lift the upper beam as soon as the exhaust of steam pressure from the main intensifier cylinder permits the pull-back pressure to lift the upper shear beam and force the water in the main shear cylinders back into the intensifier cylinders.

Preliminary to opening of the steam exhaust from the intensifier the wedges are lifted, permitting the upper beam and knife to fall away (laterally) from the lower beam and knife, and the rollers 66 are lifted. The upper knife is thus freed from contact with the lower knife and with the plate, giving a free upward stroke for the upper knife, and the plate is lifted clear of the lower knife.

The operations of the distance adjustment between the shears and the scrap cutting knife are obvious.

In the form shown in Figure 3 I have applied my invention diagrammatically to two hydraulic shears 24^2 or 25^2, having two cylinders 22^2, 23^2 each, connecting a separate high pressure intensifier cylinder 9, 10, 11 and 12 through separate piping 14′, 14^2, 15′, 15^2 with each of the four cylinders of the shears. This insures equal flow of high pressure liquid to each cylinder but, in case of unequal resistance at the shears, tends to throw the intensifier plungers out of line and would make it desirable to provide additional side support in the form of guides or long bearing surfaces for the plungers in order to maintain them in axial line. The entire synchronization here is hydraulic.

In Figure 4, I have shown hydraulic shears 24^3, 25^3, of any character, having separate cylinders 22^2, 23^2 fed by separate lines of piping 14′, 14^2, 15′, 15^2 from high pressure intensifier cylinders, which in this case are balanced across the axis of intensifier plunger movement, in that each cylinder 22^2, 23^2 is fed from two intensifier cylinders such as 9 and 11, 9′ and 11′, 10 and 12, 10′ and 12′, with the purpose and effect of balancing the intensifier mechanically as well as hydraulically, as in the case of the intensifier shown in Figure 2 so that there will be no tendency to cant the intensifier plungers and each shear cylinder will receive the same rate and quantity of hydraulic flow. This control also is purely hydraulic.

It will be seen, therefore, that there are various ways in which the cylinders may be insured uniform rates of fluid flow, protecting by mechanical or hydraulic or mixed mechanical and hydraulic means against one cylinder leading the other in the same hydraulic shear and insuring equal rate of speed for each shear.

It will be obvious that the same principles which make my invention specially valuable for shears make it desirable also for use with hydraulic tools generally, including punches and presses of every type, whether with a single cylinder each or a plurality of cylinders each, and, in connection with my other illustration, already described, I show the synchronization of two tools having one cylinder each in Figure 5 to point this fact. The high pressure intensifier cylinders are coupled across the center as in Figure 2 so as to supply each tool cylinder 22^2 with intensifier liquid from balanced high pressure intensifier cylinders. Uniform rate of flow of liquid to the cylinders is controlled by hydraulic means.

In all of the forms either one of the opposing shears can be operated without the other by opening the by-pass valve 19 and the valve 19′ or 19² in the connections to the shear to be used and closing the valve 19² or 19′ in the connections to the shear which is not to be used. This is of advantage to gain additional speed, to cut the edges of tapered sheets or to economize on power and to safeguard against undue concentration of intensifier pressure on the one shear while it is being used alone.

It will be obvious that in the event of coupling a two-cylinder hydraulic tool to operate simultaneously with a single cylinder hydraulic tool, either the two-cylinder tool would best be fed from twice the number of high pressure intensifier cylinders that is used to feed the single cylinder hydraulic tool or the plunger of the single cylinder should be given an operative area equal to the operative areas of the two cylinders of the other tool. However, any predetermined proportions may be maintained by which the feed to the two tools provides equal movements in both, with simultaneous operation.

It will be evident also that though, for convenience, I have referred to the source of hydraulic pressure as an intensifier, because the intensifier is more economical and more generally available than any other source of corresponding pressures (and the question of whether or not the final pressure used upon the shear be greater than that which is applied to the primary piston of this fluid source is immaterial to my invention since I contemplate no other requirement from it than that it shall distribute equally and uniformly from different cylinders) it would therefore serve my purpose equally well if a multi-cylinder pump were used, with proper synchronism of the pump movements to maintain the supply for the separate cylinders of the shear from separate pump cylinders. My purpose would also be served by the use of a device corresponding otherwise to a steam intensifier but in which a high pressure liquid is used in the primary cylinder; and this would be equally true whether the cross sectional area of the primary cylinder equaled the cross sectional area of the distributing cylinders (the secondary cylinders of the device) or not.

In other words the increase of pressure in what I term an intensifier in my specification and claims is not an essential feature but the sub-division and direction i. e., equalized distribution of the energy obtained at the requisite pressure, however secured, is the essential feature. It is my purpose therefore that the word intensifier be read with this meaning.

It will be obvious that all or a part of my invention may be presented in other forms, as well as in other tools, as appeals to the whim or need of those skilled in the art; and it is my purpose to include all such forms and tool applications within my invention as come within its reasonable spirit and scope.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In the art of operating hydraulic shears, the novelty which consists in synchronizing hydraulically the operation of the movable blades of two separate pairs of shearing blades cutting in different planes, one pair from the other, and operating them hydraulically upon the same work.

2. In the invention according to claim 1, the novelty which consists in supplying the cylinders for operation of the movable blades of the different pairs of blades from different high pressure cylinders of the same intensifier.

3. In the invention according to claim 1, the novelty which consists in synchronizing the operation of the separate cylinders for operation of the same movable blades and concurrently synchronizing the operation of the movable blades of the separate pairs.

4. In the art of operating the cylinders of different hydraulic shears cutting in different planes by pressure from different high pressure cylinders of the same intensifier, the novelty which consists in connecting different cylinders of the same shear to separate intensifier high pressure cylinders, so as to synchronize the cylinders of the shear as well as to synchronize the shears.

5. In the art of operating the cylinders of different hydraulic shears cutting in different planes by pressure from the different high pressure cylinders of the same intensifier, the novelty which consists in uniting the high pressure intensifier cylinders in pairs staggered across the axis of the intensifier and in connecting the pairs with the cylinders of the different hydraulic shears.

6. In the art of operating cylinders of different hydraulic shears cutting in different planes from different high pressure cylinders of the same intensifier arranged in pairs, staggered across the axis of the intensifier, the novelty which consists in supplying the cylinders of the individual shears also from separate pairs of intensifier cylinders.

7. A pair of facing hydraulic shears cutting in different planes in combination with intensifier means for synchronizing their operation.

8. A pair of fluid-controlled facing opposite-counterpart reciprocating shears, in combination with common means for supplying fluid to operate them synchronously.

9. Two hydraulic shears cutting in different planes having a common intensifier connection.

10. A pair of hydraulic shears having two cylinders each, one at each end of the shear and a cylinder and piston controlling flow of operating fluid to each of the four shear cylinders and common to all of them.

11. Two hydraulic shears cutting in different planes and each having operating cylinders, in combination with a single intensifier having separate hydraulic cylinders connected to the operating cylinders of the shears.

12. Two hydraulic shears cutting in different planes having two cylinders each in combination with a single intensifier supplying the cylinders of both shears.

13. A pair of hydraulic shears cutting in different planes having two cylinders each in combination with intensifier operating and synchronizing mechanism therefor balanced with respect to the axis of the intensifier.

14. An intensifier having separate high pressure cylinders and a pair of hydraulic shears cutting in different planes operated simultaneously from different cylinders thereof and synchronized to move both shears at the same rate of speed.

15. Two hydraulic shears cutting in different planes having two operating cylinders for each shear in combination with hydraulic means for synchronizing the movements in the two cylinders of one shear with respect to the two cylinders of the other shear and in each cylinder of each shear as respects the other cylinder of the same shear.

16. Two hydraulic shears cutting in different planes having two operating cylinders each, in combination with an intensifier having a plurality of high pressure cylinders and separate connections from each of the shear cylinders to a different one of an equal number of high pressure intensifier cylinders.

17. A pair of hydraulic shears cutting in different planes having a plurality of cylinders each, in combination with a single intensifier having separate high pressure intensifier cylinder connection for each cylinder of the hydraulic shears to synchronize the operation of all of the cylinders.

18. Two hydraulic shears cutting in different planes having two operating cylinders each, in combination with an intensifier supplying said cylinders and having eight high pressure intensifier cylinders arranged in pairs across the axis of the intensifier, a different pair of intensifier cylinders being connected with each of the operating cylinders of the hydraulic shears.

19. In hydraulic machinery, an intensifier having a plurality of high pressure cylinders connected in pairs, the two cylinders of each pair lying on opposite sides of the axis of the intensifier, in combination with a plurality of separate hydraulic shears cutting in different planes and connections from each pair of intensifier cylinders to operate a different hydraulic shear.

20. A pair of facing hydraulic shears cutting in different planes, cylinders for operation of the separate shears, means for adjusting the shears with respect to each other and an intensifier and connections feeding the cylinders of both shears.

21. A pair of parallel hydraulic shears cutting in different planes having knives each of which begins to cut at the same end and in which the cutting point progresses in the same direction in both shears, in combination with hydraulic synchronizing means for the two shears.

22. A pair of parallel hydraulic shears cutting in different planes having knives each of which begins to cut at the same end and in which the cutting point progresses in the same direction in both shears, in combination with hydraulic synchronizing means for the two shears and means for synchronizing the movements of opposite ends of each of the individual shears.

23. A pair of hydraulic shears cutting in different planes having operating cylinders, an intensifier having a number of high pressure cylinders, operating connections to the cylinders of the shears from different ones of the intensifier cylinders and by-pass connections for diverting the operating fluid from the high pressure cylinders connected with one shear to assist in the operation of the other shear.

24. A pair of opposite counterpart guillotine shears having the knives cutting progressively in the same general direction and placed facing each other to cut on opposite sides of the same work, cylinders and connections for fluid operation of each of the shears, an intensifier and connections from the high pressure cylinders of the intensifier to the cylinders of the two shears whereby the shears are operated in unison.

CHARLES L. HUSTON.