United States Patent [19]

Mace

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[54] **SHUTOFF DEVICE FOR WELLS**

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[52] **U.S. Cl.** **72/407,** 166/55

[51] **Int. Cl.** **B21d 22/04**

[58] **Field of Search** 72/407, 416, 295, 367; 166/55, 166/298

[56] **References Cited**

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[57] **ABSTRACT**

A device for shutting-off well drilling and pipe strings and the like has a pair of opposed frame members arranged with a string between them and displaceable with respect to one another. Two pairs of jaws are mounted on the frame members for guidingly engaging the string when the frame members are displaced toward one another. Each frame member is provided with a fluid motor having an I-beam mounted on the piston thereof and arranged for movement with respect to the I-beam of the opposed frame member. These I-beams move relatively to the respective frame member for flattening a portion of the string to shut off same. Locking devices are provided on the frame members for locking themselves together after displacement toward one another, thus preventing the frame members from moving away from one another while the string is being flattened by the fluid motors and I-beams.

19 Claims, 7 Drawing Figures

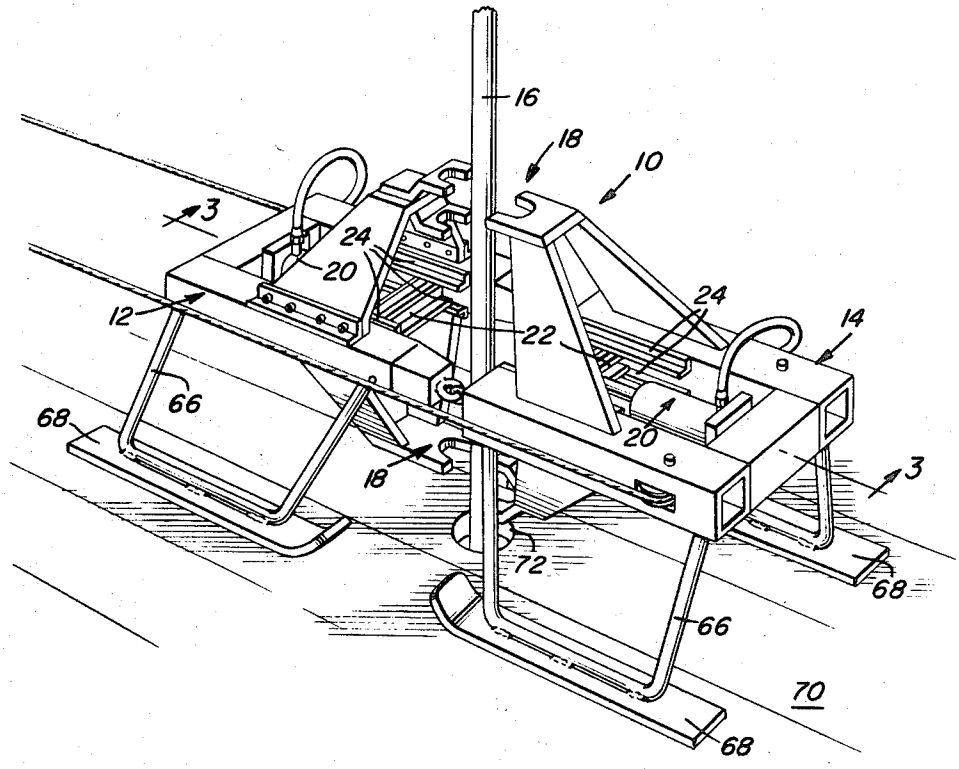


Fig. 1

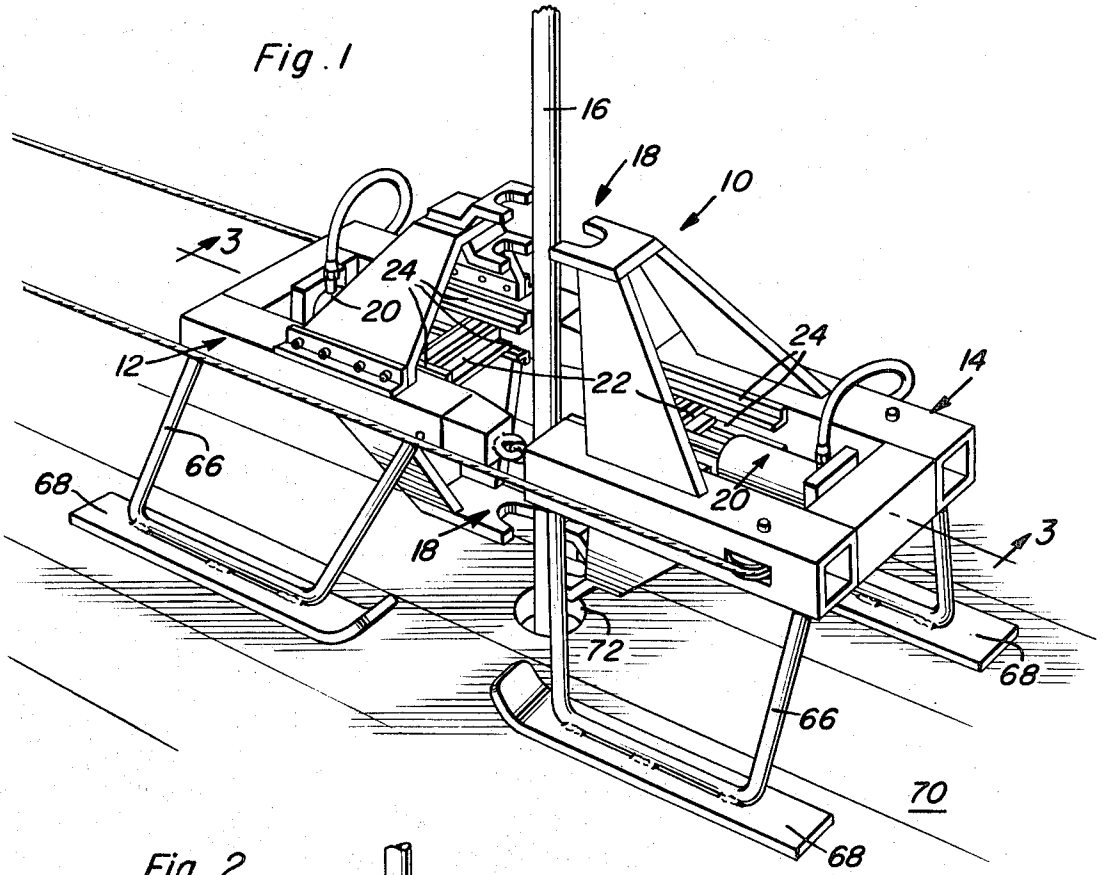


Fig. 2

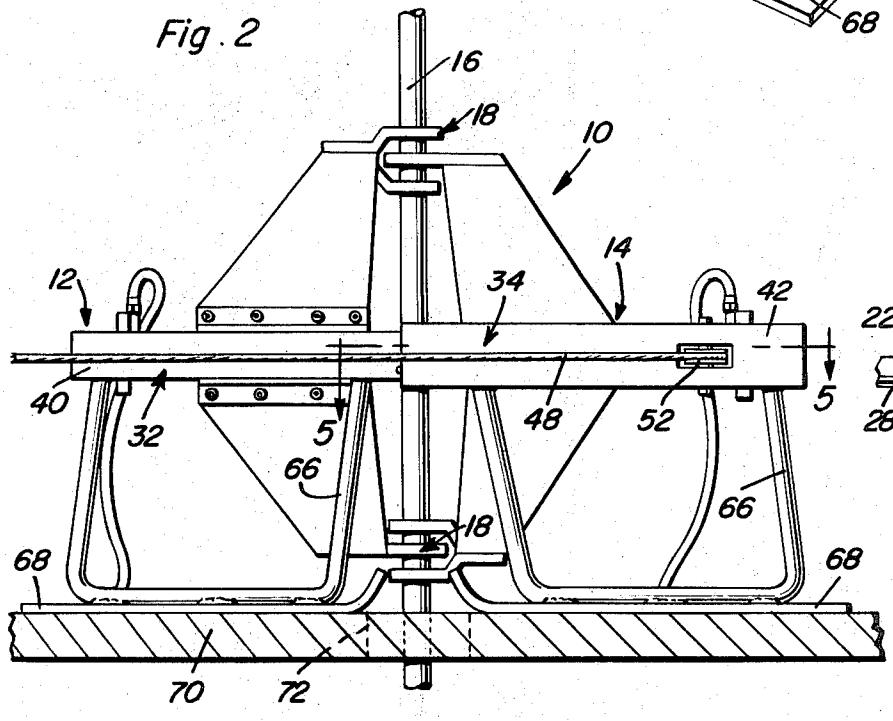


Fig. 7

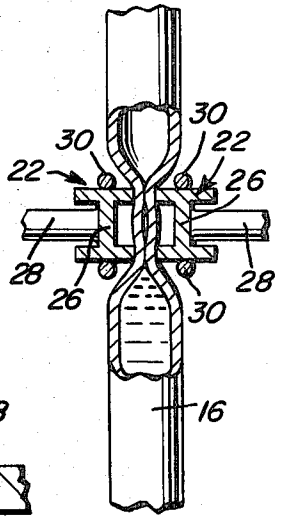


Fig. 3

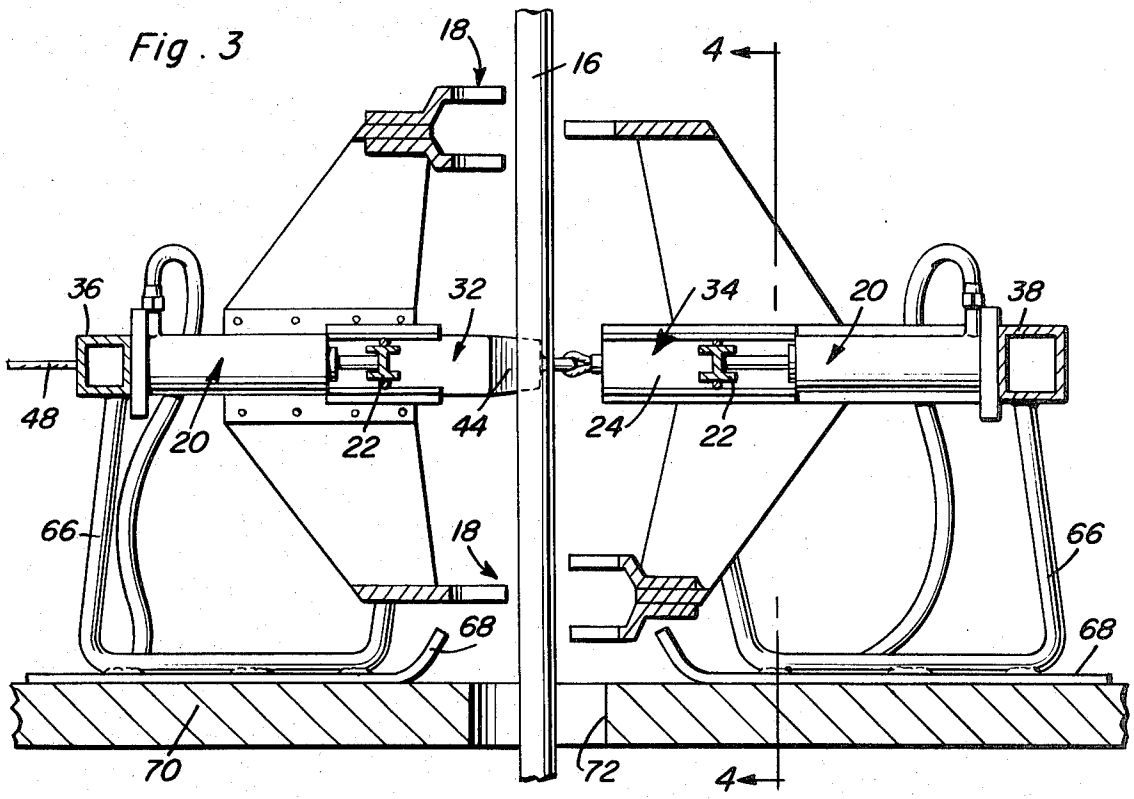


Fig. 4

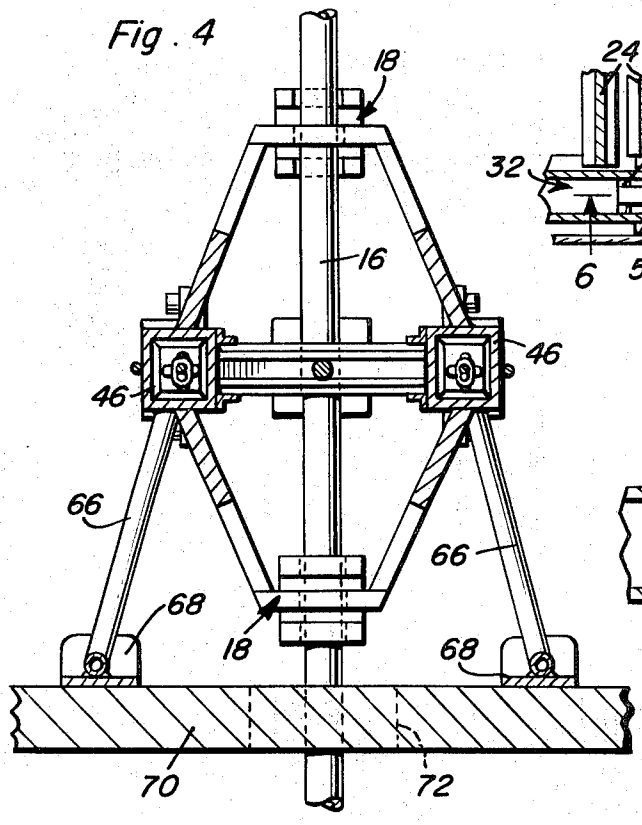


Fig. 5

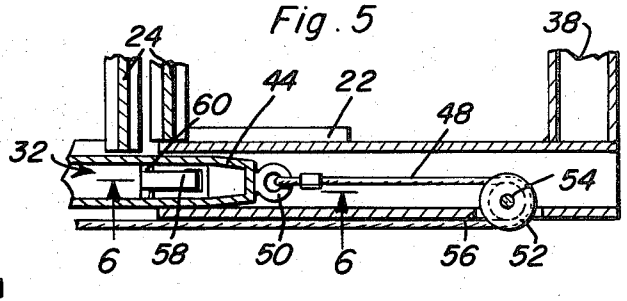
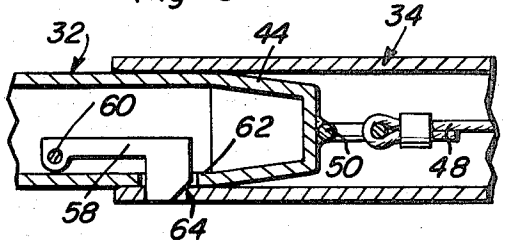


Fig. 6



SHUTOFF DEVICE FOR WELLS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a positive safety shutoff device for gas and oil wells and the like, and in particular to such a device which can be used to shut off any well, either on land or water without requiring special modification of the well itself. Such a device provides protection in the event of a blowout or other emergency.

2. Description of the Prior Art

Particular in the drilling of oil and gas wells, as well as in wells which are producing, there is the danger of a blowout, or sudden and violent escape of gas or oil when a high pressure pocket of same is encountered. Numerous devices and techniques have been proposed to prevent or control the escape of the gas and oil when a blowout occurs. These devices come under the general heading of blowout preventers.

A method has been set out in U.S. Pat. No. 3,277,964 for controlling the discharge of combustible fluids from oil wells and the like. However, this method requires that a plurality of lateral tunnels be provided from the ground surface to the borehole. These tunnels require considerable expenditure of materials and effort, and do not provide a technique which is practical for use on every oil, gas, and like wells.

Another approach to solving the blowout problem has been the use of control gates, an example of which is shown in U.S. Pat. No. 2,969,838. This type of device is arranged about a string in the manner of a collar, and has hydraulic rams which shut off the string, and may even shear-off same. However, this construction involves much precision machine-work in order that the device may operate properly when needed. Further, this type of blowout preventer is intended to be inserted into the pressure control assembly of the well, resulting in increased setup cost.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a positive shutoff device for preventing blowouts in oil, gas, and like wells which is simpler and more reliable in construction than known devices of this type, and which is easily transported and set up at a well site.

These and other objects are achieved according to the present invention by providing a device for shutting-off well drilling and pipe strings and the like, and which has a pair of opposed frame members arranged with a string between them and displaceable with respect to one another. Means are provided on the frame members for guidingly engaging the string when the frame members are displaced toward one another, and means are also provided on the frame members for relative movement with respect thereto for flattening a portion of the string and shutting off same.

In a preferred embodiment of the present invention, the frame members are each formed by a pair of spaced, parallel side rails and an end rail connected to the side rails at one end portion of each. The other end portion of each side rail extends co-directionally and toward the side rails of the opposed frame member for mating therewith. The other end portions of the side rails of one frame member are tapered toward the opposed side rails, and the other end portions of the side rails of the other frame member are provided with cavity means for receiving the tapered end portions. A line may be attached to the tapered end portions and to a pulley arranged in an opening provided in the other side rails. This line is arranged around the pulley for displacing the frame members toward one another.

The frame members are advantageously further provided with means for locking themselves together after displacement toward one another. This locking prevents displacement of the frame members away from one another during the flattening procedure.

In a preferred embodiment of the present invention, the locking means includes latch members arranged in the tapered end portions of the one side rails, and a means arranged in the other end portions for engaging with the latch members. The latch members may engage with the engaging means by the force of gravity.

An advantageous feature of the present invention has the relative movement means including opposed fluid motors, and flattening means connected to the fluid motors for moving toward and away from the means of the opposed fluid motor. This flattening means may be rams in the shape of I-beams having a web attached to the free end of a respective piston rod.

The guidingly engaging means preferably has two opposed pairs of jaws mounted on the frame members for movement therewith; opposed pairs of jaws arranged spaced from opposite sides of the frame members.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing the shutoff device according to the present invention arranged about a well string.

FIG. 2 is a side elevational view, partly in section, showing a device according to FIG. 1 in a string-shutoff position.

FIG. 3 is a sectional view taken generally along the line 3—3 of FIG. 1.

FIG. 4 is a sectional view taken generally along the line 4—4 of FIG. 3.

FIG. 5 is a fragmentary sectional view taken generally along the line 5—5 of FIG. 2.

FIG. 6 is a fragmentary sectional view taken generally along the line 6—6 of FIG. 5.

FIG. 7 is a fragmentary, detail view, partly in section, showing the manner in which the device according to the present invention shuts off a well string.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now more particularly to FIG. 1 of the drawings, a device **10** according to the present invention for shutting-off well drilling and pipe strings and the like has a pair of opposed frame members **12, 14** arranged with a string **16** between them and for displacement with respect to one another. Two pairs of opposed jaws **18** are mounted on frame members **12, 14** for movement therewith, and for guidingly engaging string **16** when frame members **12, 14** are displaced toward one another. Opposed pairs of jaws **18** are arranged spaced from opposite sides of frame members

12, 14. Opposed fluid motors 20 are mounted in frame members 12, 14 for relative movement with respect thereto, and include cylinder and piston assemblies. Each cylinder and piston assembly is connected to an I-beam 22 arranged for moving toward and away from a similar I-beam 22 connected to the opposed fluid motor 20, and guided by guides 24. When I-beams 22 move toward one another relative to the respective frame member 12, 14, a portion of string 16 is flattened (FIG. 7) and shut off. I-beams 22 are connected by webs 26 (FIG. 7) to the free end of a respective piston rod 28. Rods 30, which may be, for example, spark-proof bronze bar stock, are mounted on the flanges of I-beams 22 for guidingly engaging guides 24.

Each frame member 12, 14 is formed by a pair of spaced, parallel side rails 32, 34, respectively, and an end rail 36, 38, respectively, connected to side rails 32, 34 at one end portion 40, 42 of each. The other end portions of each side rail 32, 34 extend co-directionally and toward side rails 34, 32 of the opposed frame member for mating therewith.

Other end portions 44 of side rails 32 are tapered toward the opposed side rails 34, and the other end portions of side rails 34 are provided with cavities 46 (FIG. 4) for receiving tapered end portions 44. Lines 48 (FIG. 5) may be attached to tapered end portions 44, as by conventional I-bolts 50. Pulleys 52 are arranged for rotation on stub shafts 54 in openings 56 provided in side rails 34. Lines 48 are then arranged around pulleys 52 for displacing frame members 32, 34 toward one another by exerting a force in any suitable, known manner on the ends of lines 48. The force applied to lines 48 may be supplied either manually or by some machine.

Frame member 12, is further provided with latch members 58 pivotally arranged on pins 60 mounted in tapered end portions 44 of side rails 32. Slots 62 are also provided in tapered end portions 44, and are arranged for the projecting free end of latch members 58 to pass therethrough. Slots 64 are arranged in the other end portions of side rails 34, those defining cavities 46, for engaging with latch member 58 and locking frame members 12, 14 together after their displacement toward one another. This locking prevents displacement of frame members 12, 14 away from one another during the flattening procedure. As can be understood from FIG. 6 of the drawings, latch member 58 will engage with slot 64 by the force of gravity.

Referring again to FIGS. 1 to 4 of the drawings, each frame member 12, 14 is provided with a pair of tubular supporting frames 66 which may be attached thereto in a suitable, known manner, such as by welding. A skid 68 is attached in a similar manner to a respective supporting frame 66. Skids 68 are provided to permit frame members 12, 14 to be displaced over a surface on which device 10 is placed. As shown in the drawings, this surface may be a platform 70 provided with an opening 72 for permitting string 16 to pass therethrough. Alternatively, skid 68 may be placed directly on the earth surface (not shown) surrounding the casing head (not shown) of the well. This arrangement would place it beneath the drill platform (not shown) provided for the derrick (not shown) commonly used in cable drilling.

As can be appreciated from the above description and the drawings, a device 10 according to the present invention may be economically manufactured and easily transported. Once in position about a string 16 of an oil, gas, and the like well, either on land or water, it is effective as a safety device for blowouts. If the well explodes, a button (not shown) could be pushed starting fluid or other actuated devices (not shown) for applying a force to lines 48 and drawing frame members 12, 14 together. A suitable, known control system (not shown) could be used to actuate fluid motors 20 in proper sequence once frame members 12, 14 are locked together. Jaws 18 would guidedly grip string 16, and together with the locking devices in side rails 32, 34, assure that I-beams 22 come together in a parallel manner for flattening a portion of string 16. In locations where pollution caused by a blowout is not a serious threat to the environment, device 10 could be set up for manual operation. The latter would result in even greater savings over known blowout preventive devices.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

I claim:

1. A device for shutting-off well drilling and pipe strings, comprising, in combination:
   a. a pair of opposed, separate frame membeers arranged with a string between them and displaceable toward and away from the string and one another;
   b. means mounted on said frame members for selectively displacing said frame members toward one another; and
   c. means for relative movement with respect to the frame members for flattening a portion of the string to shut off same.

2. A structure as defined in claim 1, wherein the frame members are each formed by a pair of spaced, parallel side rails and an end rail connected to the side rails at one end portion of each, the other end portion of each side rail extending co-directionally and toward the side rails of the opposed frame member for mating therewith.

3. A structure as defined in claim 2, wherein the other end portions of the side rails of one frame member are tapered toward the opposed side rails, and the other end portions of the side rails of the other frame member are provided with cavity means for receiving the tapered end portions.

4. A device for shutting-off well drilling and pipe strings, comprising, in combination:
   a. a pair of opposed frame members arranged with a string between them, and displaceable with respect to one another, each of the frame members formed by a pair of spaced, parallel side rails and an end rail connected to the side rails at one end portion of each, the other end portion of each side rail extending co-directionally and toward the side rails of the opposed frame member for mating therewith, the other end portions of the side rails of one frame member being tapered toward the opposed side rails, and the other end portions of the side rails of the other frame member being provided with cavity means for receiving the tapered end portions, a line

being attached to at least one of said tapered end portions and a pulley being arranged in an opening provided in the mating one of said other side rais, said line being arranged around said pulley for displacing said frame members toward one another;

b. means mounted on said frame members for guidingly engaging the string when said frame members are displaced toward one another; and

c. means for relative movement with respect to the frame members for flattening a portion of the string to shut off same.

5. A structure as defined in claim **4,** wherein said frame members are further provided with means for locking themselves together after displacement toward one another for preventing displacement of the frame members away from one another.

6. A structure as defined in claim **5,** wherein the locking means includes a latch member arranged in at least one of the tapered end portions, and a means arranged in the mating one of the other end portions of the side rails opposed to the tapered end portions for engaging with the latch member, said latch member engaging with the engaging means by the force of gravity.

7. A structure as defined in claim **4,** wherein the relative movement means includes opposed fluid motors mounted on said frame members, and flattening means connected to the fluid motors for moving toward and away from the flattening means of the opposed fluid motor.

8. A structure as defined in claim **7,** wherein the fluid motors are cylinders and pistons having piston rods, and the flattening means is I-beams, each beam having a web attached to a free end of a respective piston rod.

9. A structure as defined in claim **4,** wherein the guidingly engaging means includes two opposed pairs of jaws mounted on the frame members for movement therewith, the two opposed pairs of jaws arranged spaced from opposite sides of the frame members.

10. A structure as defined in claim **1,** wherein said frame members are further provided with means for locking themselves together after displacement toward one another for preventing displacement of the frame members away from one another.

11. A device for shutting-off well drilling and pipe strings, comprising, in combination:

a. a pair of opposed frame members arranged with a string between them, and displaceable with respect to one another, said frame members being provided with means for locking themselves together after displacement toward one another for preventing displacement of the frame members away from one another, the locking means including at least one latch member arranged in one of said frame members, and a means arranged in the other of said frame members for engaging with the latch member;

b. means mounted on said frame members for guidingly engaging the string when said frame members are displaced toward one another; and

c. means for relative movement with respect to the frame members for flattening a portion of the string to shut off same.

12. A structure as defined in claim **11** wherein the relative movement means includes opposed fluid motors mounted on said frame members, and flattening means connected to the fluid motors for moving toward and away from the flattening means of the opposed fluid motor.

13. A structure as defined in claim **12,** wherein the fluid motors are cylinders and pistons having piston rods, and the flattening means is I-beams, each beam having a web attached to a free end of a respective piston rod.

14. A structure as defined in claim **13,** wherein the guidingly engaging means includes two opposed pairs of jaws mounted on the frame members for movement therewith, opposed pairs being arranged spaced from opposite sides of the frame members.

15. A device for shutting-off well drilling and pipe strings, comprising, in combination:

a. a pair of opposed frame members arranged with a string between them, and displaceable with respect to one another;

b. means mounted on said frame members for guidingly engaging the string when said frame members are displaced toward one another; and

c. means for relative movement with respect to the frame members for flattening a portion of the string to shut off same, the relative movement means including opposed fluid motors mounted on said frame members, and flattening means connected to the fluid motors for moving toward and away from the flattening means of the opposed fluid motor.

16. A structure as defined in claim **15,** wherein the fluid motors are cylinders and pistons having piston rods, and the flattening means is I-beams, each beam having a web attached to a free end of a respective piston rod.

17. A structure as defined in claim **15,** wherein the guidingly engaging means includes two opposed pairs of jaws mounted on the frame members for movement therewith, opposed pairs being arranged spaced from opposite sides of the frame members.

18. A structure as defined in claim **15,** wherein the guidingly engaging means includes two opposed pairs of jaws mounted on the frame members for movement therewith.

19. A structure as defined in claim **18,** wherein opposed pairs of jaws are arranged spaced from opposite sides of the frame members.

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