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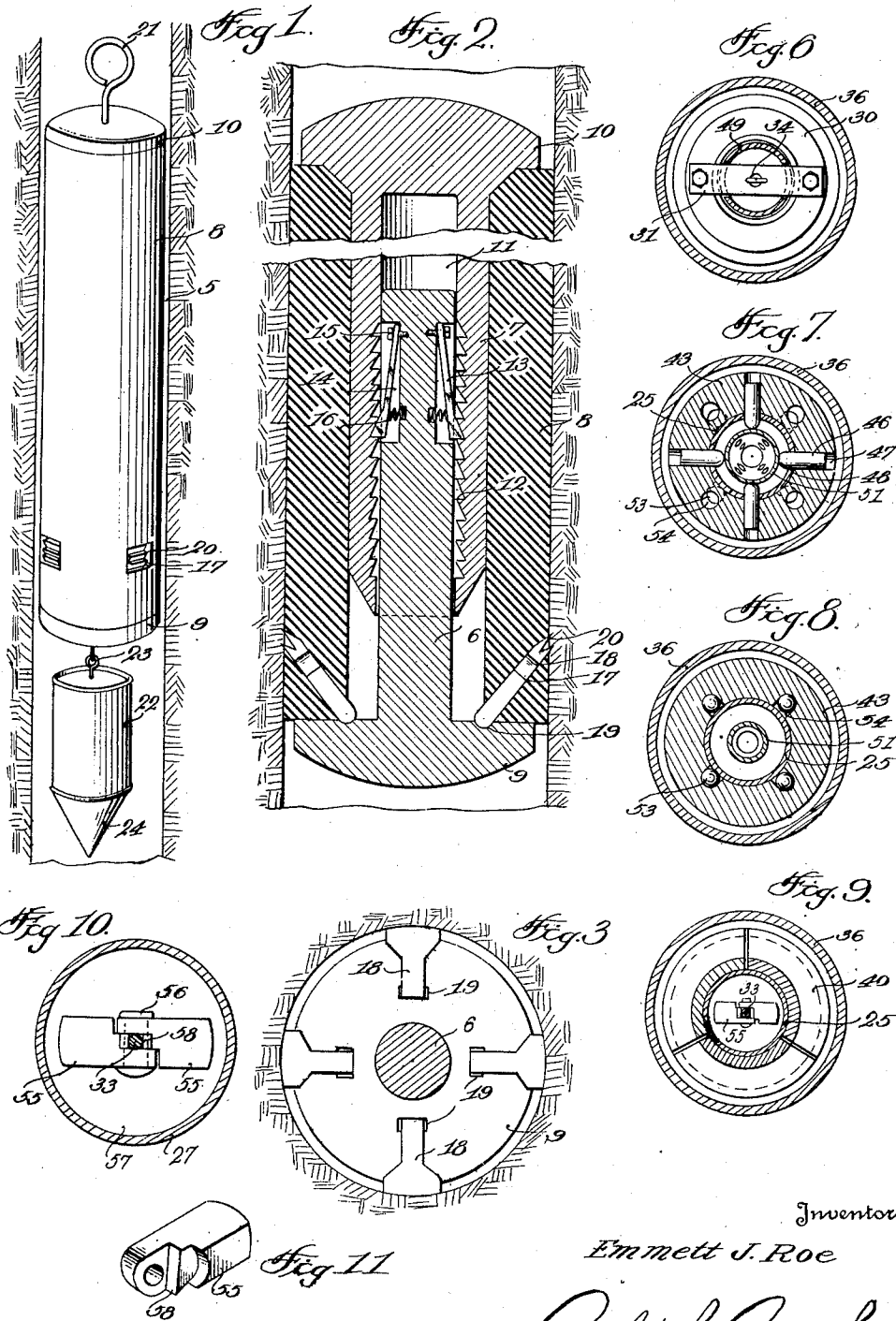
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2 Sheets-Sheet 1



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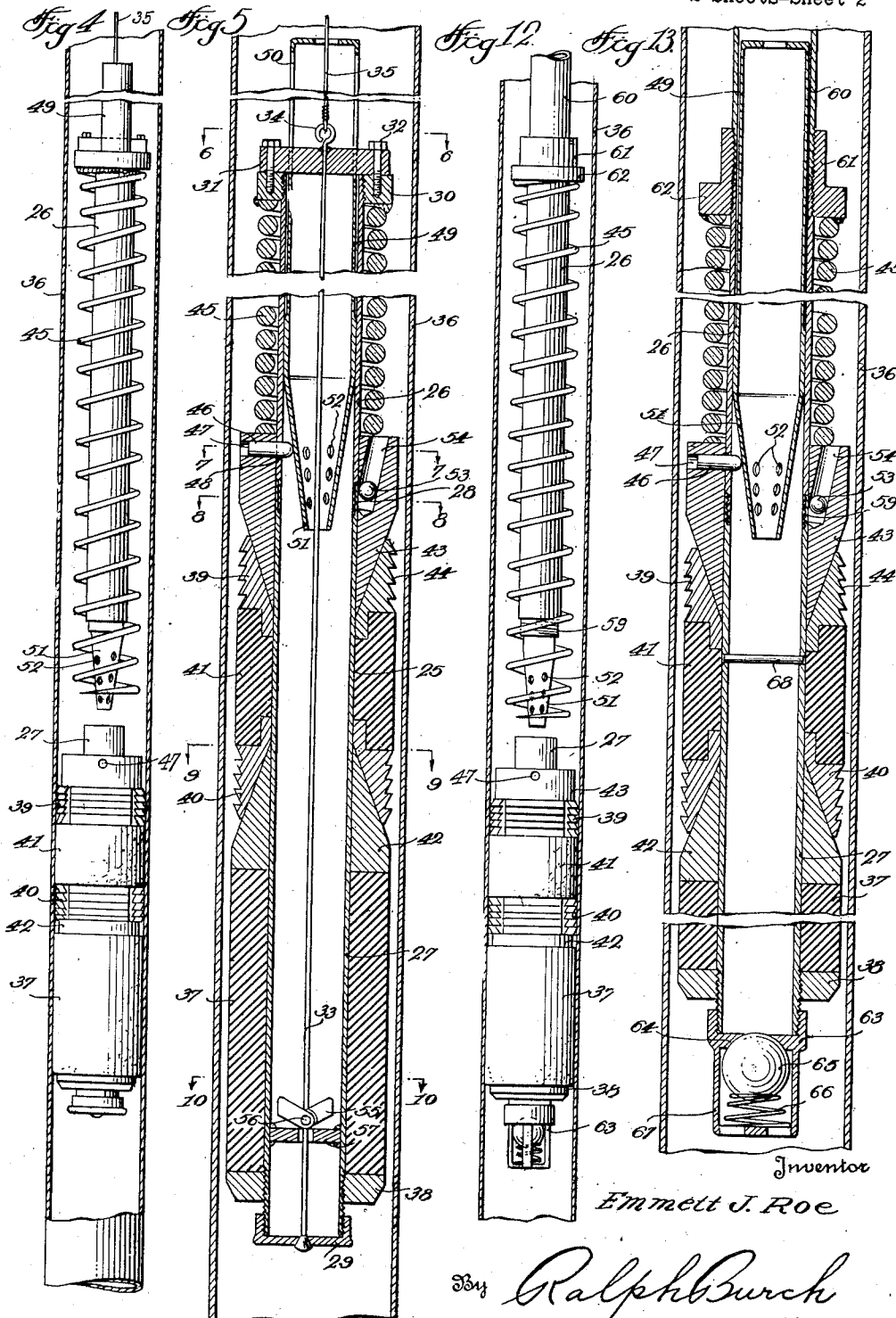
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WELL PLUGGING DEVICE

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13 Claims. (Cl. 166—13)

This invention relates to improvements in well-plugging devices for closing the bottom of a well hole or sealing the well casing at points intermediate its length.

It is now common practice in oil field areas having a plurality of strata of oil at various depths to drill a single well through all the strata of oil and then successively take the oil from the various strata. The oil is first taken from the lowermost stratum, and when the supply is exhausted the casing is perforated at the next stratum to remove the oil therefrom, and the operation is repeated until the oil has been removed from all the strata. After the oil is removed from one stratum, and before perforating the casing at the next stratum, it is necessary to set a plug in the casing just below the point of perforating the casing to prevent water from rising in the casing, or oil from flowing down in the casing. The present plugs employed for this purpose are crude in design and are difficult to set, requiring considerable time and expense, which is objectionable.

It is an object of the invention to provide a well plug which may be readily lowered into position in the well hole and then set by dropping a string of tubing or drilling tools onto the plug.

A further object of the invention resides in providing an expansible plug having gripping dogs adapted to be automatically projected into gripping engagement with the walls of the well upon expansion of the plug into set position.

A still further object of the invention resides in a method of forcing a sealing compound around the bottom of the plug when the plug is set.

A still further object resides in providing a plug which may be lowered into the well casing and set at any point throughout the length of the casing.

A still further object resides in providing a plug which may be set at any point throughout the length of a well casing, the plug being composed of separable parts detachably connected together whereby a part of the plug may be removed from the well casing after setting the plug.

A still further object resides in providing a casing plug which will serve as a cement retainer, the plug having a passage through the center for the passage of a fluid under pressure.

Another object of the invention resides in providing a device of the above-mentioned character which is simple and durable in construction, reliable and efficient in operation, and inexpensive to manufacture.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this specification and in which like numerals are employed to designate like parts throughout the same,

Fig. 1 is a perspective view of the plug for sealing the bottom of a well hole, with the sealing paste container attached thereto,

Fig. 2 is a longitudinal sectional view of the plug in expanded position,

Fig. 3 is a cross sectional view showing the relative position of the gripping dogs,

Fig. 4 is an elevation of a modified form of plug showing the parts in separate relation after setting the plug,

Fig. 5 is a longitudinal sectional view of the plug shown in Fig. 4 before setting,

Fig. 6 is a cross sectional taken on line 6—6 of Fig. 5,

Fig. 7 is a cross section taken on line 7—7 of Fig. 5,

Fig. 8 is a cross section taken on line 8—8 of Fig. 5,

Fig. 9 is a cross section taken on line 9—9 of Fig. 5,

Fig. 10 is a cross section taken on line 10—10 of Fig. 5,

Fig. 11 is a perspective view of one of the cutter jaws,

Fig. 12 is a side elevation of a modified form of plug for use as a cement retainer, and

Fig. 13 is a longitudinal sectional view of the plug shown in Fig. 12 before setting.

In the drawings, wherein for the purpose of illustration I have shown a preferred embodiment of my invention, the numeral 5 denotes the plugging device, in its entirety, consisting of telescoping male and female members 6 and 7, surrounded by a tubular expansible body 8 constructed of rubber or other suitable material. The body 8 is confined between the heads 9 and 10 formed integral with the outer ends of the male and female members, respectively. The bore 11 of the female member 7 is provided with a series of ratchet teeth 12 adapted to be engaged by the spring-pressed latches 13 mounted in recesses 14 formed in the male member 6. The latches 13 are loosely secured in the recesses 14 at one end, by bolts 15, and coil springs 16 are disposed between the free ends of the latches and bottom of the recesses to normally press the latches outwardly into engagement with the ratchet teeth 12. When the male and female members are tele-

scoped together, the elastic body 8 is compressed, causing it to expand outwardly into engagement with the walls of the well or well casing. As more clearly shown in Fig. 2, the body 8 adjacent its lower end is provided with diagonal openings 17 arranged around the circumference of the body at equally spaced distances, and slidably mounted in the openings are locking dogs 18, the lower ends of which are seated in recesses 19 formed in the head 9 of the male member. When the body 8 is compressed, the head 9 moves the dogs 18 upwardly, so that their upper ends, which are formed with teeth 20, project beyond the body into biting engagement with the wall of the well. An eye hook 21 is attached to the head 10 of the plug for attaching a measuring line or sand line thereto, for lowering the plug into the well.

In plugging the bottom of a well hole, it is sometimes desired to seal the hole beneath the plug with an acid-resisting compound. For this purpose, I have provided a container 22 for the sealing compound adapted to be suspended from the head 9 of the plug by a hook 23. The lower end of the container 22 is tapered, as at 24, and when the plug is lowered into the bottom of the well and force applied to set the plug, the container will be bursted and the sealing compound will be distributed by hydraulic pressure around the bottom of the plug and into the walls of the well.

In operation, when it is desired to seal the bottom of a well hole with the plug shown in Fig. 1, the plug is lowered into the well by means of a measuring or sand line which is detached therefrom after the plug reaches the bottom. The plug may be set by applying force thereto either through the use of a string of tubing or a set of drilling tools. When force is applied to the plug, the male and female members 6 and 7 are telescoped together and locked in position by the latches 13. The telescoping of the members 6 and 7 causes the body 8 to be compressed and expanded radially into engagement with the walls of the well. At the same time the body 8 is expanded the dogs 18 are moved upwardly so that their free ends project beyond the body into biting engagement with the walls of the well, thus firmly securing the plug in its set position. If it is desired to use a sealing compound, the container 22 containing the compound is suspended from the bottom of the plug and lowered into the well with the plug. When the plug is set the force applied to the plug will burst the container and the compound will be forced around the plug into the walls of the well.

When it is desired to set a plug at a point intermediate the length of the casing, the type of plug shown in Figs. 4 and 5 is employed. This plug consists of a pipe 25 composed of upper and lower sections 26 and 27 joined together by a slip joint 28 which permits separation of the sections. The lower end of the pipe is closed by a screw cap 29 and a ring 30 is threaded on the upper end of the pipe which supports the cross bar 31 attached to the ring by screw bolts 32. A wire 33 extending centrally and longitudinally of the pipe is connected at one end to the cap 29 and at its other end to the cross bar 31, thus serving to hold the sections of the pipe together. The upper end of the wire is provided with an eye 34 to which the wire line 35 is attached for lowering the plug in the well casing 36. An expansible rubber

sleeve 37 is mounted on the lower end of the pipe 25 with its lower end resting on the head 38 secured on the lower end of the pipe. Above the sleeve 37 are upper and lower sets of gripping dogs 39 and 40 which surround the pipe, the two sets of dogs being connected together with a flexible sleeve 41 which spaces the sets of dogs apart. The inner sides of the dogs are beveled and the lower set of dogs 40 rides on the tapered surface of the head 42 slidably mounted on the pipe and secured to the upper end of the sleeve 37, while the upper set of dogs 39 rides on the tapered surface of the head 43 slidably mounted on the pipe 25 above the gripping dogs. The outer faces of the gripping dogs are provided with teeth 44 and, upon downward movement of the head 43, the sets of dogs riding on the tapered surfaces of the heads 42 and 43 are caused to move outwardly into gripping engagement with the walls of the well casing. The head 43 is forcibly moved downwardly by an expansible coil spring 45 mounted on the pipe 25 between the head 43 and ring 30, the upper end of the spring being fixedly attached to the ring by welding or otherwise. The spring is held compressed by means of pins 46 slidably mounted in transverse openings 47 in the upper end of the head 43 which are adapted to engage in openings 48 in the wall of the pipe 25 above the slip joint of the pipe sections. The head 43 is provided with a plurality of the pins 46 arranged circumferentially of the head in spaced relation. A tubular mandrel 49 is slidably mounted in the upper end of the pipe 25 which is provided with opposed longitudinal slots 50 through which the cross bar 31 extends. The lower end of the mandrel is tapered, as at 51, and the wall of the tapered portion is provided with a series of openings 52. Upon downward movement of the mandrel the tapered end 51 contacts the pins 46 forcing them outwardly to release the head 43 which is moved downwardly by the expansion of the spring 45. The head 43 is held in its set position by clutch balls 53 which freely move in the pockets 54 formed in the head 43 at points intermediate the pins 46. The pockets 54 extend vertically of the head at an angle to the pipe 25 with their lower ends in open communication with the outside wall of the pipe to permit frictional contact between the clutch balls and pipe whereby the head is permitted to move downwardly but is automatically secured against upward movement. When the head 43 is moved to a set position it is disposed entirely below the slip joint 28 so that the upper section 26 of the pipe and its associated parts may be removed from the well casing, as shown in Fig. 4 upon cutting of the wire 33 connecting the pipe sections together.

The wire 33 is automatically severed by a pair of opposed cutting jaws 55 pivotally mounted on the transverse pin 56 disposed in the lower end of the pipe section 27 directly above the bridge plate 57. The wire extends through an opening in the pin 56 and the cutting edges 58 of the jaws, as clearly shown in Fig. 11, rest against the wire with the free ends of the jaws extending upwardly in diverging relation. As the mandrel 49 moves downwardly, its lower end contacts the free ends of the jaws so as to rock the jaws and cause their cutting edges to sever the wire.

In setting the plug, it is lowered into the well casing by the line wire to the desired point,

as shown in Fig. 5. A godevil or steel rod is then dropped into the well casing and upon striking the mandrel 49 drives the mandrel downwardly in the pipe 25. As the mandrel moves downwardly it first contacts the pins 46 which are moved outwardly from engagement with the openings 48 of the casing, thus releasing the head 43 which under the expansible action of the spring 45 is forcibly driven downwardly. The driving force of the head 43 causes the sleeve 37 to expand into sealing engagement with the wall of the well casing and also causes the gripping dogs 39 and 40 to be expanded into gripping relation with the well casing, thus securing the plug in set position. As the mandrel continues its movement it contacts the cutting jaws 55 actuating the jaws to sever the wire 33 holding the pipe sections together. With the wire 33 severed, the upper section of the pipe is free and may be removed from the well casing by the line wire together with the spring 45 which is fixed to the ring 30 carried by the upper section of the pipe. Thus, it is seen a part of the plug is recovered after setting which may be used again.

Where it is desired to use a packer or cement retainer for the purpose of pumping any fluids through and retaining a pressure on the same, the plug shown in Figs. 12 and 13 is employed. This plug is similar in construction to the plug shown in Figs. 4 and 5, but differs therefrom in the following particulars. The pipe sections 26 and 27 are connected together by a left-hand threaded joint 59, and the wire 33, screw cap 29, wire cutting jaws 55, cross bar 31, and ring 30 are eliminated. The upper end of the pipe 25 is connected to the lower end of the tubing 60 by means of the usual right-hand threaded coupling 61 having a flange 62 at its lower end against which the spring 45 is seated and secured thereto. The lower end of the pipe 25 is equipped with a check valve 63 including a seat 64 for the ball valve 65 which is normally held seated by the spring 66 supported in the cage 67 beneath the ball valve. In this type of plug the mandrel 49 is shorter and is limited in its downward movement by a transverse pin 68 fixed in the lower pipe section, whereby the mandrel when driven downwardly to set the plug remains in covering relation to the openings 48 in the wall of the pipe.

In use, this plug is set in the same manner as the plug shown in Figs. 4 and 5, excepting it is found necessary to move the tubing upward slightly after the spring has been released to effect a tight grip between the plug and well casing. After the plug is set, any fluids under pressure may be pumped through the tubing and plug into the area of the well beneath the plug. The check valve 63 allows the fluid to pass through the pipe but automatically closes after the passage of the fluid, thus maintaining the pressure which has been applied. When the pumping operation is completed, the tubing is turned to the right, causing the pipe sections to be uncoupled at their joint so that the upper section, together with the spring, may be removed from the well.

In the devices shown in Figs. 5 and 13, it will be seen the holding dogs 39 and 40 are disposed above the packing sleeve 37, so that after the plug is set any additional pressure below the plug will act upon the packing sleeve and tend to further expand the sleeve, so that the greater the pressure the tighter the plug will be set, thus

preventing any leaks due to irregularities in the shape of the casing.

It is to be understood that the forms of my invention herein shown and described are to be taken as preferred examples of the same and that certain changes in the shape, size, and arrangement of the parts may be made without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described my invention, I claim:

1. A well plugging device comprising a pipe composed of separable sections, a wire connecting the sections of said pipe together, an expansible sleeve mounted on the lower section of said pipe, a spring mounted on the upper section of said pipe adapted to apply force to expand said sleeve, means for holding said spring retracted, a cutter for severing said wire, and means for releasing said last-mentioned means and operating said cutter.

2. A well plugging device comprising a pipe, an expansible sleeve mounted on the lower end of said pipe, sets of gripping dogs mounted on said pipe above said sleeve, said sets of dogs being disposed in spaced apart relation and connected together by a flexible sleeve, a head slidably mounted on said pipe above said dogs, a spring mounted on said pipe above said head adapted to move said head longitudinally of said pipe to expand said dogs and sleeves, latching means carried by said head for holding said spring contracted, and means for releasing said latching means.

3. A well plugging device comprising a pipe, an expansible sleeve mounted on the lower end of said pipe, sets of gripping dogs mounted on said pipe above said sleeve, said sets of dogs being disposed in spaced apart relation and connected together by a flexible sleeve, a head slidably mounted on said pipe above said dogs, a spring mounted on said pipe above said head adapted to move said head longitudinally of said pipe to expand said dogs and sleeves, latch pins carried by said head and engageable in openings in said pipe to hold said spring retracted, and a mandrel slidably mounted in said pipe adapted to release said pins when moved longitudinally of said pipe.

4. A well plugging device comprising a body composed of separable sections, an expansible sleeve on the lower section of said body, an expansible spring on the upper section of said body for expanding said sleeve, means for holding said spring contracted, means connecting said sections of said body together, means for severing said connecting means, and means for releasing said holding means and operating said severing means.

5. A well plugging device comprising a body member, wall gripping dogs mounted on said member, yieldable means normally retaining said dogs in inoperative position, and cooperating means on said member and dogs whereby relative axial movement between the dogs and said member will cause said dogs to move radially outward to operative position.

6. A well plugging device comprising a body member, wall gripping dogs mounted on said member, yieldable means normally retaining said dogs in inoperative position, means slidable on said body cooperating with said dogs to expand said dogs to operative position, and spring operated means for imparting movement to said last mentioned means.

7. A well plugging device comprising a body member, wall gripping dogs mounted on said

member, yieldable means normally retaining said dogs in inoperative position, means slidable on said body to expand said dogs to operative position, means releasably holding said last mentioned means in inoperative position, and means for imparting movement to said slidable means upon release of said releasable means.

8. A well plugging device comprising a body member, wall gripping dogs mounted on said member and capable of radial movement with respect thereto, yieldable means normally holding said dogs in retracted position, setting means slidably mounted on said member and operable to expand said dogs, releasable means for holding said setting means in inoperative position, and means exerting a constant pressure on said setting means.

9. A well plugging device comprising a body member, wall gripping dogs mounted on said member and capable of radial movement with respect thereto, yieldable means normally holding said dogs in retracted position, setting means slidably mounted on said member and operable to expand said dogs, means for holding said setting means in inoperative position, and means for releasing said last mentioned means.

10. A well plugging device comprising a body member, an expansible packer sleeve mounted on the lower end of said body, wall gripping dogs mounted on said member above said packer sleeve and capable of radial movement with respect thereto, yieldable means normally holding said dogs in retracted position, setting means slidably mounted on said member and operable to expand said dogs, and means for exerting a

pressure on said setting means and member to move said means and member in opposite directions whereby said dogs and packer sleeve are simultaneously set.

11. A well plugging device comprising a body member composed of upper and lower sections, a packer carried by said lower section, wall gripping dogs carried by said lower section, mechanism for setting said dogs carried by said upper section, shearable means connecting said sections together, and means for shearing said means to permit separation of the sections.

12. A well plugging device comprising a body member composed of upper and lower sections, shearable means connecting said sections together, a packer carried by said lower section, wall gripping dogs carried by said lower section, mechanism for setting said dogs carried by said upper section, latching means for holding said mechanism in inoperative position, severing means for said shearable means, and means for releasing said latching means and operative to actuate said severing means.

13. A well plugging device comprising a body member composed of upper and lower sections detachably connected together, a packer carried by said lower section, wall gripping dogs carried by said lower section, a member movable on said body for setting said dogs, a clutch for holding said member in set position, and mechanism for actuating said member carried by said upper section and removable therewith after said dogs are set.

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