March 14, 1967 R. T. EVANS 3,308,886

RETRIEVABLE BRIDGE PLUG

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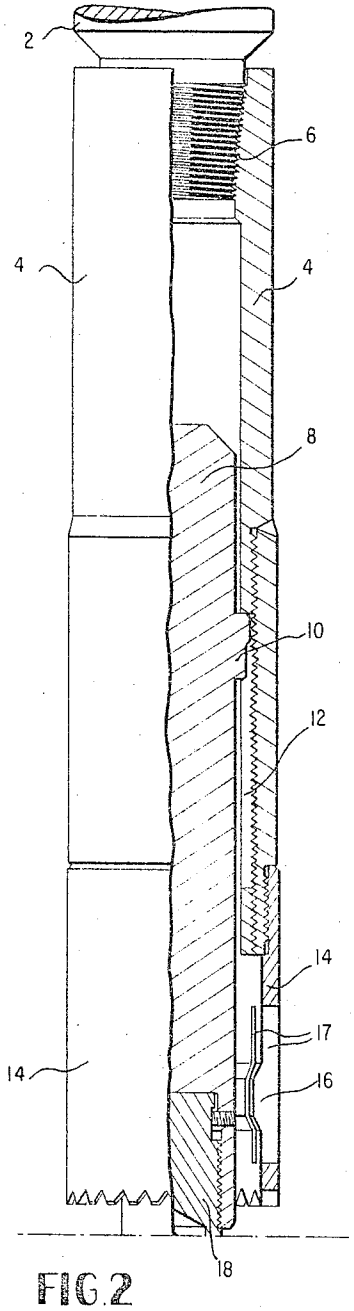


FIG. 2

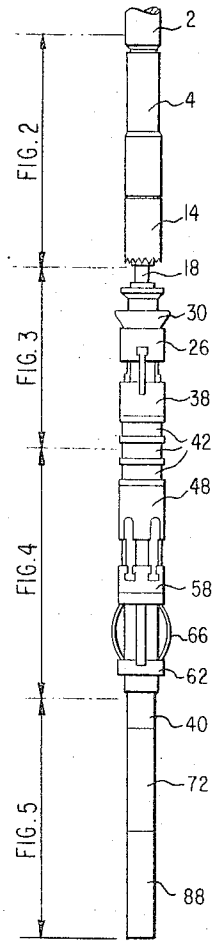
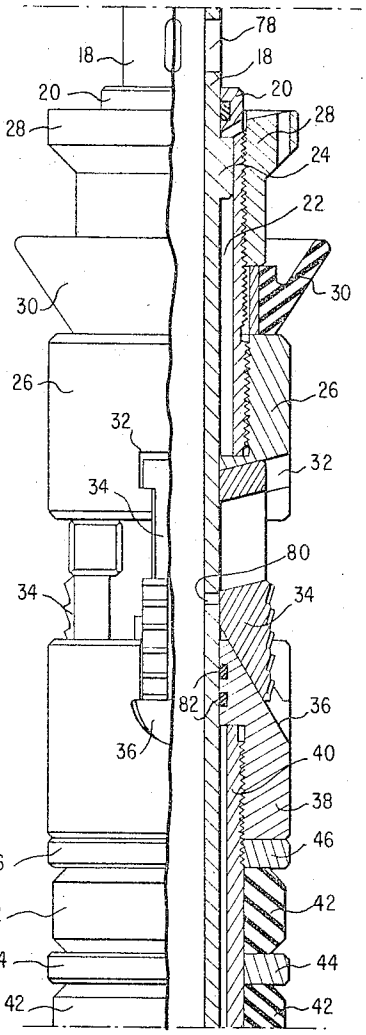


FIG. 1

FIG. 3



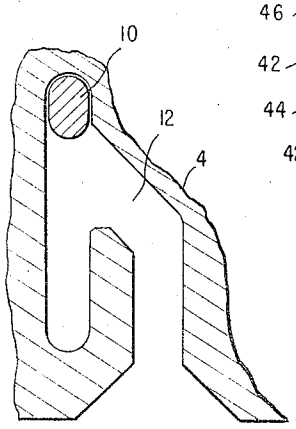


FIG. 2A

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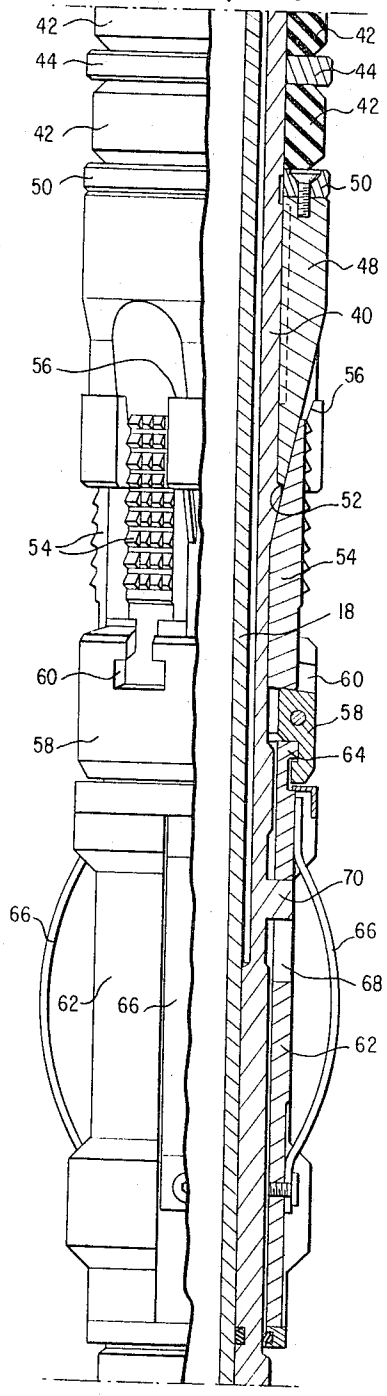
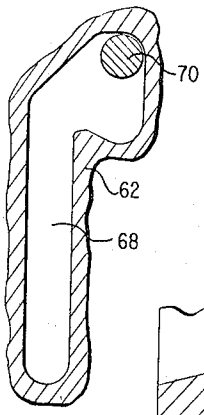


FIG. 4

FIG. 4A



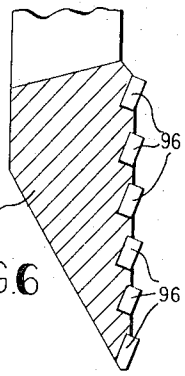


FIG. 6

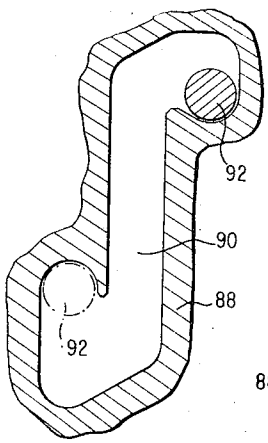


FIG. 5A

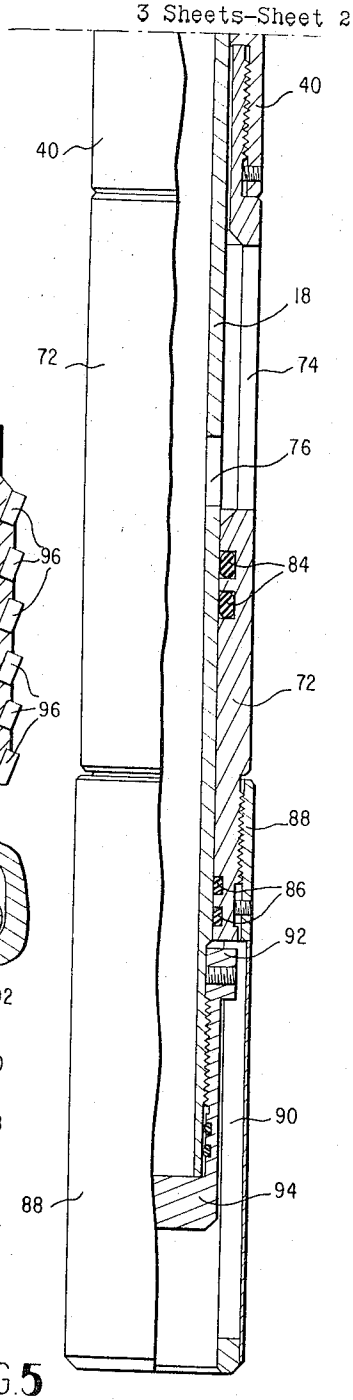


FIG. 5

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FIG. 7

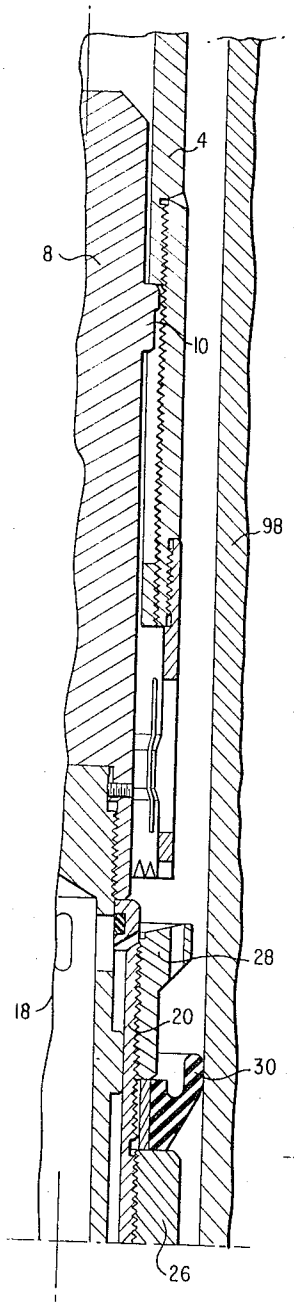


FIG. 8

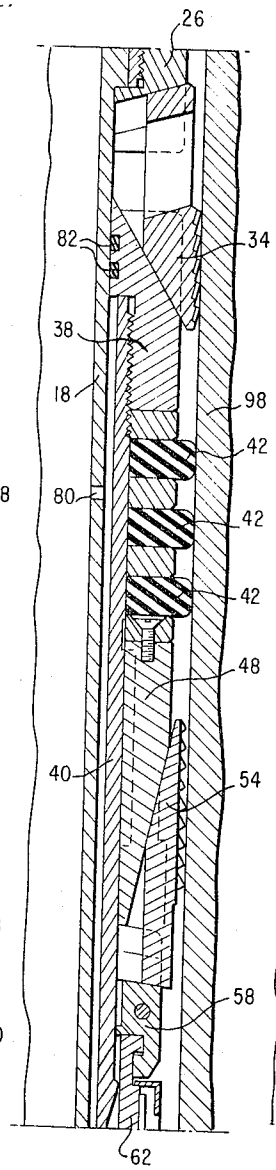


FIG. 9

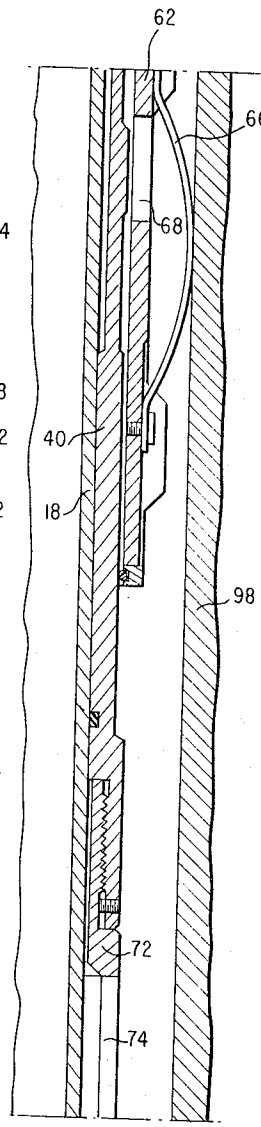
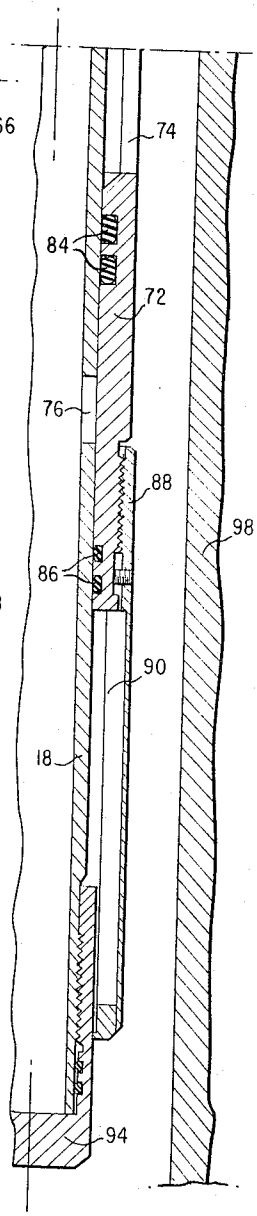


FIG. 10



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RETRIEVABLE BRIDGE PLUG

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Filed Dec. 26, 1963, Ser. No. 333,499
14 Claims. (Cl. 166—134)

This invention relates to a retrievable bridge plug and, more particularly, to a packer type retrievable bridge plug.

A packer type bridge plug includes packer rings which are expanded against the casing to separate one portion of the well from another. The common method of expanding the packer rings is to utilize fluid pressure to provide the force to distort the rings sufficiently for them to engage the well casing. Usually, fluid pressure not only expands the packer rings, but also maintains the packer rings in the set position. Fluid pressure differentials for expanding the packer rings are created by O-rings, or other types of seals. Since the seals are exposed to well fluids and high subsurface temperatures, they become deteriorated rapidly and failure of the seals may cause the packer rings to collapse unexpectedly.

Another problem associated with packer type bridge plugs is that a fluid pressure differential acting across the packer rings often causes the packer to be displaced in the casing. Slips may be provided on the bridge plug to resist its displacement, but the slips are actuated in response to the pressure differential on the packer rings. They are in a neutral or non-engaging position when no pressure differential exists. As the pressure differential changes from one face of the packer ring to the opposite face, the slips must disengage the casing, pass through the neutral position, then engage the casing in the opposite direction. While the slips are moving through the neutral position, the tool is free to move away from its desired position in the well, and therefore it may not be at the desired depth when the slips again engage the casing.

Accordingly, it is an object of this invention to provide a retrievable packer type bridge plug which may be set independently of fluid pressure.

It is a further object of this invention to provide a packer type retrievable bridge plug which resists movement relative to the casing after the packer is set.

It is a still further object to provide means for equalizing fluid pressure on opposite sides of the packer ring, before the ring is collapsed.

It is another object to provide a retrievable bridge plug which gives an indication at the surface after the packer is set of whether the tubing string is connected with the tool.

These objects are accomplished in accordance with a preferred embodiment of the invention by a bridge plug having packer rings mounted on a packer mandrel. A control mandrel is telescoped within the packer mandrel and a retrieving head is secured to the upper end of the control mandrel. Slips are mounted in mechanical bodies above and below the packer ring. The upper mechanical slip body is secured on the packer mandrel and the lower mechanical slip body is mounted on the packer mandrel for longitudinal movement thereon. The lower slips are set first by right-hand rotation and downward movement of the control mandrel, thereby moving a lug on the control mandrel in a J-slot. This movement of the control mandrel closes ports in the control mandrel above and below the packer rings. Drag springs engage the casing and resist movement of the drag spring sleeve while the control mandrel moves downwardly. At the same time, a lug on the packer mandrel moves out of a locked position in a J-slot in the drag spring sleeve. The slips move outwardly along an inclined surface on the lower mechanical slip body until they engage the casing. As the control mandrel moves downwardly, a shoulder on the mandrel engages the upper slip control body, thereby displacing the body downwardly relative to the lower slips. The downward movement of the slip control body moves an inclined surface on the upper mechanical slip body under the upper slips to displace them outwardly against the casing. At this point, the upper and lower slips are in engagement with the casing, but the packer rings are not yet expanded.

The downward force which is applied by the control mandrel to the slip control body causes the slip control body, the upper slips and the upper mechanical slip body to move downwardly. Since downward movement of the lower mechanical slip body relative to the casing is resisted by the lower slips which grip the casing, the packer rings are compressed axially and expand radially outwardly against the casing. During the expansion of the packer rings, the upper slips slide along the casing wall. The teeth on the slips slope away from the casing toward the packer rings, so that they do not bite into the casing until the slips are urged in the upward direction. After the packer rings are expanded, the upper slips bite into the casing to keep the packer rings expanded and to prevent movement of the tool. Continued right-hand rotation of the control mandrel, after the packer rings are expanded, moves the lug on the control mandrel into a locked position in its J-slot. The control mandrel then cannot be moved upwardly.

The bridge plug is released from the tubing by right-hand rotation and upward movement of the tubing string to cause a lug on the retrieving head to move out of the open end of a J-slot in the overshot. An overshot nose on the lower end of the overshot has an internal circumferential ridge. The diameter of the retrieving head plus the length of the lug is slightly greater than the internal diameter of the ridge, so that there is an interference fit between the lug and the ridge. Accordingly, a greater upward pull on the tubing string is required to raise the overshot nose across the lug, thereby serving as an indication at the surface that the bridge plug is set and that the overshot is released.

The control mandrel is provided with radial ports for equalizing fluid pressure in the annular space between the tool and the casing above and below the packer rings. When the control mandrel is displaced upward relative to the packer mandrel, the ports are opened, but when the control mandrel is displaced downward, the ports are closed, thereby blocking fluid communication through the tool, when the packer rings are set.

This preferred embodiment of the invention is illustrated in the accompanying drawings in which:

FIG. 1 is a schematic elevational view of the retrievable bridge plug of this invention attached to a tubing string;

FIG. 2 is an elevational view, partially in section, of the top portion of the bridge plug, as indicated in FIG. 1;

FIG. 2A is a schematic view of the J-slot in the overshot;

FIG. 3 is an elevational view, partially in section, of the upper intermediate section of the bridge plug, as indicated in FIG. 1;

FIG. 4 is an elevational view, partially in section, of the lower intermediate portion of the bridge plug, as indicated in FIG. 1;

FIG. 4A is a schematic view of the J-slot in the drag spring sleeve;

FIG. 5 is an elevational view, partially in section, of the bottom portion of the bridge plug, as indicated in FIG. 1;

FIG. 5A is a schematic view of the control J-slot in the J-slot body;

FIG. 6 is an enlarged cross sectional detail view of one of the upper slips;

FIG. 7 is a cross sectional view of the top portion of the bridge plug, after the packer rings have been set in a well casing;

FIG. 8 is a cross sectional view of the upper intermediate portion of the bridge plug, after the packer rings have been set;

FIG. 9 is a cross sectional view of the lower intermediate portion of the bridge plug, after the packer rings have been set; and

FIG. 10 is a cross sectional view of the bottom portion of the bridge plug after the packer rings have been set.

The retrievable bridge plug is attached to a coupling **2** on the end of a tubing string. An overshot **4** has internal screw threads **6** which cooperate with the threads on the coupling **2** to secure the overshot **4** to the coupling **2**. A retrieving head **8** is telescoped in the overshot **4** and a lug **10** on the retrieving head cooperates with an internal J-slot **12** in the overshot **4** to control the position of the retrieving head **8** relative to the overshot. An overshot nose **14** is secured to the lower end of the overshot. The nose **14** has a ridge **16** extending around the interior wall of the nose. The diameter of the retrieving head plus the length of the lug **10** is slightly greater than the internal diameter of the ridge **16**, thereby forming an interference fit therebetween. The wall of the nose **14** has a plurality of slots **17** which allow the nose to expand slightly as the lug **10** is forced over the ridge **16**. The retrieving head is secured by screw threads to the upper end of a control mandrel **18**. The mandrel **18** extends downward from the retrieving head **8** to the lower end of the bridge plug.

A slip control body **20** is telescoped over the control mandrel **18** and relative movement between the body **20** and the mandrel **18** is controlled by a cylindrical recess **22** in the body **20**. A collar **24** on the mandrel **18** is movable in the recess **22**. At the lower end of the body **20**, an upper slip retainer ring **26** is secured to the body **20** by screw threads. A junk catcher **28** is also threadedly secured on the slip control body **20** and a resilient cup **30** is clamped between the junk catcher **28** and the slip retainer ring **26** to prevent sand settlement around the upper slip assembly.

The slip retainer ring **26** has a plurality of T-slots **32** spaced around the circumference of the ring **26** and upper slips **34** each have one end mounted in one of the T-slots **32**. The lower end of each slip **34** has lateral flanges for cooperating with inclined T-slots **36** in a mechanical slip body **38**. The T-slots **36** slope downwardly, so that upon downward movement of the slips **34**, they will move outwardly in the slots **32** and **36**. The upper mechanical slip body **38** is movable longitudinally along the control mandrel **18** and is threadedly secured to a packer mandrel **40**. A plurality of packer rings **42** and spacer rings **44** are mounted on the mandrel **40** for sliding movement relative thereto. A spacer ring **46** is also threaded on the mandrel **40** between the slip body **38** and the first packer ring **42**. A lower mechanical slip body **48** on the mandrel **40**, having a spacer ring **50** secured thereto, is movable upwardly along the mandrel **40**. A shoulder **52** on the mandrel **40** prevents downward displacement of the body **48** relative to the mandrel and facilitates retraction of the lower slips. A plurality of slips **54** are spaced around the circumference of the packer mandrel **40** and each slip has one end mounted in one of the inclined T-slots **56** formed in the lower mechanical slip body **48**. The slips are retained in their respective T-slots **56** by lateral flanges on opposite sides of the slips. A split ring collar **58** having T-slots **60** formed therein is

mounted on the packer mandrel **40** below the slips **54** and the opposite end of each lower slip **54** is mounted in one of the T-slots **60**. A drag spring sleeve **62** is mounted on the packer mandrel **40**, as shown in FIG. 4, and the collar **58** extends over a flange **64** on the sleeve **62**, so that the collar **58** and the sleeve **62** are connected together. Drag springs **66** having their opposite ends secured in the sleeve **62** are bowed outwardly to engage the walls of the casing. A J-slot **68**, as shown in FIG. 4A, is formed in the sleeve **62** and a lug **70** formed on the packer mandrel **40** extends radially outward through the J-slot **68**.

A bypass body **72** is threadedly secured to the lower end of the packer mandrel **40** and has a port **74** therein. The control mandrel **18** has bypass ports for providing fluid communication above and below the packer rings. There is a lower bypass port **76** in the control mandrel **18** in alignment with the port **74**, as shown in FIG. 5. Other bypass ports **78** and **80** are located in the control mandrel above the packer rings **42**. When the control mandrel **18** is displaced downward, O-rings cooperate with the mandrel to prevent leakage of fluid through the ports **76** and **80**. A pair of O-rings **82** are mounted in the mechanical slip body **38** to form a seal for the port **80**. The port **76** is sealed between two pairs of O-rings **84** and **86**, when the mandrel **18** is displaced downward.

A J-slot body **88** is threadedly secured to the lower end of the bypass body **72**. The J-slot body **88** is provided with a J-slot **90** having the shape shown in FIG. 5A. A lug **92** on a mandrel cap **94**, which is secured to the lower end of the control mandrel **18**, cooperates with the J-slot **90** to control the relative position of the mandrel **18**.

As shown in FIG. 6, the upper slips **34** have teeth **96** thereon for gripping the well casing. The teeth slope upwardly away from the packer rings. Therefore, the teeth on the slips **34** may slide downwardly along the casing, but movement in the upward direction causes the teeth to become wedged against the casing. The teeth may be individual segments of a hard material, such as tungsten carbide, to avoid damaging the teeth as they are sliding along the casing. The tooth segments may be set into the slip and cemented in place.

FIGS. 7 to 10 show the tool as it is set in a casing, which is shown schematically at **98**. When the packer is lowered into a well, the ports **76**, **78** and **80** communicate between the interior of the control mandrel **18** and the annular space between the packer tool and the casing. When the desired depth for setting the packer rings is reached, the mandrel **18** is given a sufficient right-hand rotation to move the lug **92** out of the short upper portion of the J-slot **90**, as shown in FIG. 5A, to the long portion of the J-slot. The drag springs **66**, which engage the casing, resist movement of the sleeve **62** and, while the lug **92** is moving into the long portion of the J-slot **90**, the lug **70** on the packer mandrel **40** moves into the long portion of the J-slot **68**. A downward force is then applied to the tubing string to displace the control mandrel **18** downwardly relative to the sleeve **62**. The downward force is transmitted through the retrieving head lug **10** which engages the top of the J-slot **12** in the overshot **14**. When the control mandrel **18** is displaced downwardly, fluid communication through the ports **76** and **80** is blocked by the respective O-rings **82**, **84** and **86**. When the mandrel **18** moves downward relative to the sleeve **62**, the lower end of the retrieving head **8** engages the slip control body **20** and the force is transmitted to the packer mandrel **40**. Downward displacement of the packer mandrel **40** and the lower mechanical slip body **48** relative to the drag spring sleeve **62** causes the lower slips **54** to move outwardly along the inclined T-slots **56** until the slips engage the casing **98**, as shown in FIG. 8. After the lower slips engage the casing, the lower mechanical slip body **48** is blocked from

further downward movement by the slips **54** which are wedged against the casing.

The upper slips **34** are then expanded by the further application of force to the tubing string. The force is transmitted to the slip control body **20** through the retrieving head **8** for displacing the slip retainer **26** downward, thereby causing the slips **34** to ride outwardly along the inclined T-slots **32** and **36**. The slips move outwardly until they engage the casing. Since the lower slips **54** are wedged against the casing, continued downward movement of the slip control body **20** axially compresses the packer rings **42** until they expand radially into engagement with the casing. The upper slips **34** slide downwardly along the casing with the upper mechanical slip body **38** while the packer rings are being expanded. The angular orientation of the teeth **96** on the upper slips **34** permits the slips to slide downwardly along the casing, but when the downward movement stops, the resiliency of the packer rings **42** urges the slips **34** upwardly and the teeth **96** are wedged into the surface of the casing, thereby resisting upward displacement of the slips. The wedging action of the upper and lower slips not only maintains the packer rings expanded, but also prevents vertical movement of the packer rings relative to the casing. The control mandrel **18** is locked in its downwardmost position by right-hand rotation of the tubing string, which moves the lug **92** into the lower short section of the J-slot **90**, as shown in phantom lines in FIG. 5A.

The tubing string may be released from the tool by right-hand rotation and upward movement of the tubing string, which moves the lug **10** on the retrieving head **8** into the open end of the J-slot **12** in the overshot **4**. The interference fit between the ridge **16** in the nose **14** and the lug **10** requires an upward pull of sufficient magnitude to indicate at the surface when the lug **10** has passed over the ridge and the overshot **4** is free from the remainder of the tool.

To collapse the packer rings and retrieve the tool, the overshot **4** is lowered over the retrieving head **8** and the lug **10** is cammed into the J-slot **12**. The weight of the tubing string is slacked off until the lug **10** moves over the ridge **16**. The shape of the J-slot **12** causes the lug **10** to be cammed into the short closed section of the J-slot, as shown in FIG. 2A. Downward movement of the control mandrel **18** moves the pin **92** out of the lower hooked section of the J-slot **90**, as shown in FIG. 5A, and left-hand rotation of the mandrel **18** moves the pin **92** into the straight portion of the J-slot. Upward movement of the mandrel **18** then opens the bypass ports **76**, **78** and **80**, to equalize the fluid pressure above and below the packer rings. Continued upward movement of the tubing string causes the collar **24** to engage the shoulder at the upper end of the recess **22** in the slip control body **20**. Upward movement of the slip control body **20** pulls the slips **34** away from the casing **98**. This is done easily, since the pull is directly on the slips **34** and the wedge angle of the slips and the T-slot **36** in the slip body **38** is a relatively large angle. A small longitudinal movement of the slips will retract the slips inwardly enough to disengage them from the casing. After the upper slips are disengaged from the casing, the packer rings **42** are free to retract by their own resilience. While the tubing string is moving upwardly, the pin **70** is cammed into the short section of the J-slot **68** and the lug **92** is moved to the upper short section of the J-slot **90**. The upward movement of the control mandrel **18** is then transmitted to the packer mandrel **40** and the shoulder **52** moves the lower mechanical slip body **48** upwardly to draw the lower slips **54** inwardly. The tool may then be removed from the well, or moved to another position in the well.

This retrievable bridge plug is an improvement over other retrievable bridge plugs now in use in that the packer rings are maintained in the sealing position by two opposing sets of mechanical slips, which positively engage the casing. Other retrievable bridge plugs depend upon internal fluid pressure retained by resilient seals which are subject to deterioration by well fluids or by high subsurface temperatures. Furthermore, the two sets of opposing slips engage the casing at all times and there can be no movement of the tool or the slips as pressure reversals occur in the well. Since the bridge plug is mechanically set by the application of downward weight to the tool, its operation is not dependent upon well fluids, or the lack of such fluids.

While this invention has been illustrated and described in one embodiment, it is recognized that variations and changes may be made therein, without departing from the invention as set forth in the claims.

1. A retrievable bridge plug comprising a packer mandrel, a packer ring mounted on said mandrel, a plurality of upper slips and lower slips on opposite sides of the packer ring, said slips being mounted in mechanical slip bodies, said packer ring being positioned between and in engagement with said mechanical slip bodies, each of said bodies having a shoulder adjacent the packer ring and having inclined surfaces cooperating with said slips to displace said slips outwardly against a well casing upon longitudinal movement of said slips relative to said slip bodies, one of said bodies being movable longitudinally along the mandrel, the other of said bodies being secured to said mandrel, and means for moving said one body toward the other body and said slips longitudinally toward each other and longitudinally relative to their respective mechanical slip bodies to expand the packer ring, whereby the slips maintain the packer ring expanded.

2. A retrievable bridge plug according to claim **1**, wherein said moving means includes a control mandrel mounted for axial movement in said packer mandrel, said control mandrel having shoulder means thereon in position to displace said slips relative to said other slip body.

3. A retrievable bridge plug according to claim **2** wherein said slips have teeth projecting outwardly therefrom, said teeth being angularly disposed and having a greater slope on the side opposite the packer ring, whereby the slips may be displaced longitudinally toward said packer ring while engaging a well casing, but resist movement away from said packer ring.

4. A retrievable bridge plug according to claim **3** wherein said slips have teeth formed of individual segments secured therein, said upper slip teeth sloping in a direction opposite to that of said lower slip teeth.

5. A retrievable bridge plug comprising a hollow control mandrel, means mounting a packer ring on said mandrel, means on the mandrel for expanding the packer ring against a well casing upon longitudinal movement of said mandrel in one direction, said expanding means including abutments on opposite sides of said packer ring, said abutments being movable toward each other to expand said packer ring outwardly by axially compressing said ring therebetween, and means on the mandrel adjacent to the packer ring for gripping the casing, said control mandrel having radial ports therein above and below the packer ring, said control mandrel being movable longitudinally of said ring expanding means and cooperating with said expanding means upon movement of said mandrel in said one direction to close the ports when the packer ring is expanded, said mandrel being movable longitudinally relative to said expanding means in a direction opposite to said one direction while said packer ring is expanded to open said ports, whereby fluid pressure on opposite sides of the packer ring is equalized before the packer ring is collapsed.

6. A retrievable bridge plug comprising a control mandrel, a packer mandrel mounted in telescoping relation on the control mandrel, a packer ring mounted on the packer mandrel, an upper slip mechanical body secured to the packer mandrel, a lower slip mechanical body mounted on the packer mandrel and movable longitudinally there-

of, slips attached individually to said upper and said lower mechanical bodies, said mechanical bodies having inclined cam surfaces cooperating with cam surfaces on said slips, drag springs, means mounting the drag springs on the packer mandrel, said drag spring mounting means being movable selectively longitudinally of the packer mandrel for camming the lower slips outwardly against a well casing, said control mandrel having means thereon for moving sequentially said mechanical bodies to displace the slips outwardly upon axial movement of the control mandrel, and means for selectively locking said control mandrel after said axial movement, whereby the packer ring and the slips are expanded against the well casing and maintained in the expanded condition.

7. A retrievable bridge plug comprising a control mandrel, a packer mandrel mounted in telescoping relation on the control mandrel, a packer ring mounted on the packer mandrel, an upper slip mechanical body secured to the packer mandrel, a lower slip mechanical body mounted on the packer mandrel and movable longitudinally thereof, slips attached at one end individually to said upper and said lower mechanical bodies, said mechanical bodies having opposed shoulders inclined cam surfaces cooperating with cam surfaces on said slips, said packer ring being positioned between said opposed shoulders, a drag spring sleeve having drag springs thereon, said sleeve being mounted coaxially on the packer mandrel below said lower mechanical body, said lower slips being attached at the opposite end of said sleeve, said drag spring sleeve and said packer mandrel including first J-slot means therebetween for limiting relative axial movement in one rotational position and permitting relative axial movement in a second rotational position, said control mandrel and said packer mandrel including second J-slot means therebetween for limiting relative axial movement in one rotational position and permitting axial movement in a second rotational position, thereby selectively camming said lower slips outwardly upon relative rotation of said sleeve and packer mandrel to said second rotational position and subsequently camming said upper slips outwardly upon downward axial movement of the control mandrel, said second J-slot means being in said one rotational position during said control mandrel axial movement and being in said second rotational position when said upper slips are displaced outwardly, thereby locking the slips and packer ring in expanded position.

8. A retrievable bridge plug according to claim 7 wherein said control mandrel includes a shoulder, said shoulder being spaced longitudinally above said upper slips, whereby said packer mandrel moves longitudinally in one direction relative to the sleeve to set the lower slips before said control mandrel shoulder displaces said upper slips against a well casing.

9. A retrievable bridge plug according to claim 8 wherein said second J-slot means includes a J-slot formed in one of said mandrels and a lug on the other of said mandrels and extending into said J-slot, said J-slot having a hook portion at the lower end thereof, whereby engagement of the lug in the hook portion prevents relative axial movement of the mandrel in response to the resilience of the compressed packer ring.

10. A retrievable bridge plug according to claim 8 wherein said slips have teeth thereon, said upper slip teeth being inclined in a direction opposite that of said lower slip teeth, said control mandrel having a second shoulder for drawing said upper slips away from the well casing upon upward longitudinal movement of said control mandrel in a direction opposite to said one direction.

11. A retrievable bridge plug according to claim 10 wherein said control mandrel has an upper port and a lower port, said packer mandrel having a port below said packer ring, said packer mandrel port being aligned with said control mandrel lower port when said lower slips are retracted and when said control mandrel is displaced in said opposite direction, and said port being misaligned when said control mandrel is displaced in said one direction relative to said packer mandrel, whereby the ports are closed during setting of the packer ring and reopened before collapse of the packer ring.

12. A retrievable bridge plug comprising a mandrel, a packer ring, means mounting the packer ring on the mandrel, upper and lower slips on opposite sides of the packer ring, means for mounting the slips on the mandrel, said mounting means including inclined surfaces cooperating with said slips to displace said upper and lower slips outwardly from said mandrel, means on said mandrel for displacing said upper and lower slips longitudinally toward said packer ring and relative to said mounting means for expanding said slips outwardly upon longitudinal movement of the mandrel in one direction, said mounting means including upper and lower abutments adjacent said packer ring, said abutments being movable toward each other upon longitudinal movement of the mandrel in said one direction for radially expanding the packer ring therebetween, and J-slot means on said mandrel for locking said mandrel independently of said slips after said longitudinal movement relative to said slip mounting means, whereby the slips and packer ring are maintained expanded.

13. A retrievable bridge plug comprising a control mandrel, a packer mandrel, a packer ring mounted on the packer mandrel, an upper slip mechanical body secured to the packer mandrel, a lower mechanical slip body mounted on the packer mandrel movable relative thereto, upper slips, means mounting the upper slips on the packer mandrel, lower slips, means mounting the lower slips on the packer mandrel, said upper and lower mechanical slip bodies having opposed shoulders and inclined cam surfaces thereon cooperating with inclined surfaces on the slips for expanding the slips against a well casing upon longitudinal displacement thereof, said packer ring being positioned between said opposed shoulders, a drag spring sleeve having drag springs thereon, said spring sleeve being mounted in coaxial relation on said packer mandrel, one of said slip mounting means being secured on said spring sleeve and the other of said slip mounting means being secured on said packer mandrel, first J-slot means for selectively displacing said control mandrel and said packer mandrel longitudinally in one direction relative to the drag spring sleeve, second J-slot means for selectively displacing said control mandrel longitudinally in said one direction relative to the packer mandrel, said control mandrel having ports therein communicating above and below the packer ring, means on said packer mandrel forming a valve for said control mandrel ports, said valve means being in position for closing said ports upon longitudinal displacement of the control mandrel in said one direction whereby when said control mandrel is displaced in said one direction in sequence, the ports are closed, the upper slips are expanded against the well casing, the lower slips are expanded against the well casing, and the packer ring is compressed by the mechanical slip bodies until it extends radially outward to engage the well casing.

14. A retrievable bridge plug comprising a control mandrel, a packer mandrel, a packer ring mounted on the packer mandrel, an upper slip mechanical body secured to the packer mandrel, a lower mechanical slip body mounted on the packer mandrel movable relative thereto, upper slips, means mounting the upper slips on the packer mandrel, lower slips, means mounting the lower slips on the packer mandrel, said upper and lower mechanical slip bodies having opposed shoulders and inclined cam surfaces thereon cooperating with inclined surfaces on the slips for expanding the slips against a well casing upon longitudinal displacement thereof, a drag spring sleeve having drag springs thereon, said sleeve being mounted coaxially on said packer mandrel, one of said slip mounting means being secured on said spring sleeve and the other of said slip mounting means being secured on said packer mandrel, first J-slot means for selectively displac-

ing said packer mandrel in one direction relative to the sleeve, said lower slips being mounted at one end on said sleeve, said sleeve restricting axial movement of such lower slips relative to said sleeve and permitting radial movement of said lower slips relative to said sleeve, thereby expanding said lower slips independently of said upper slips upon movement of said packer mandrel in said one direction, means on the mandrel for displacing said upper slips longitudinally relative to said upper slip body, said displacing means including an upper slip retaining sleeve on said mandrel and movable toward said upper mechanical slip body to expand said upper slips, and means for selectively moving said slip retaining sleeve toward said upper mechanical slip body, whereby the upper slips slide along the casing to expand the packer.

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