Nov. 14, 1967 N. W. READ 3,352,212

WELL SWAB DEVICE

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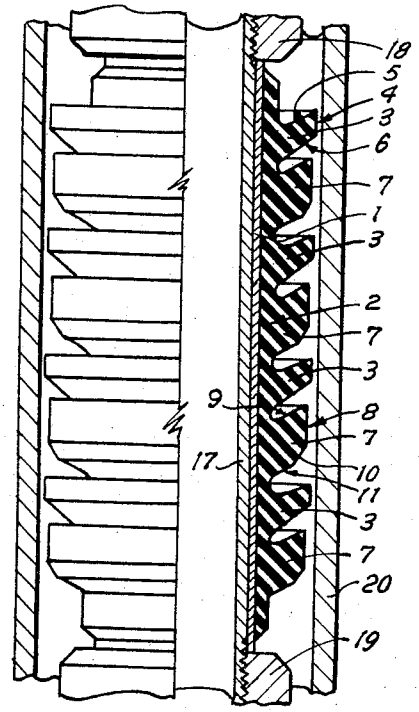


Fig. I

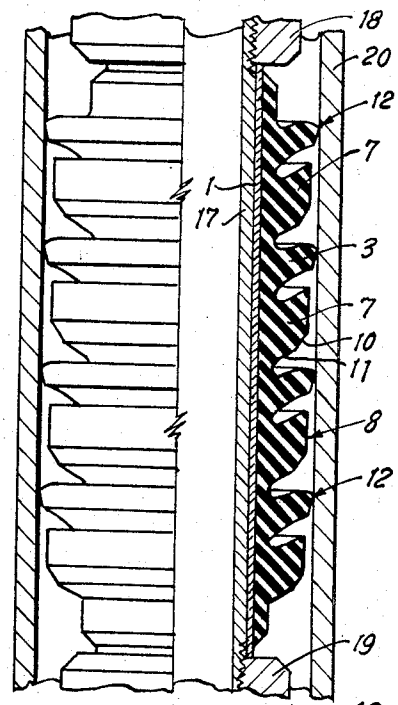


Fig. II

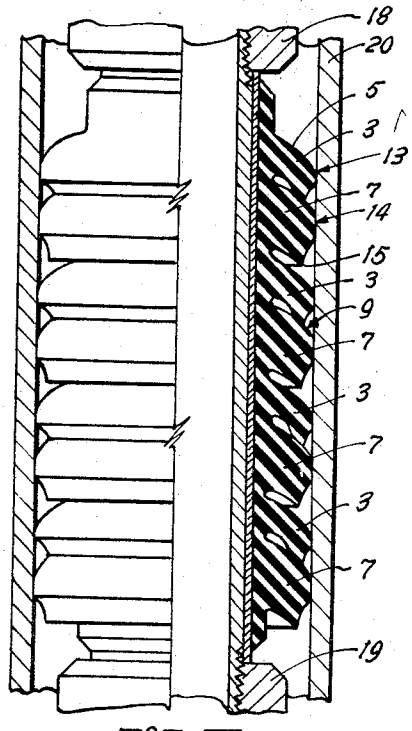


Fig. III

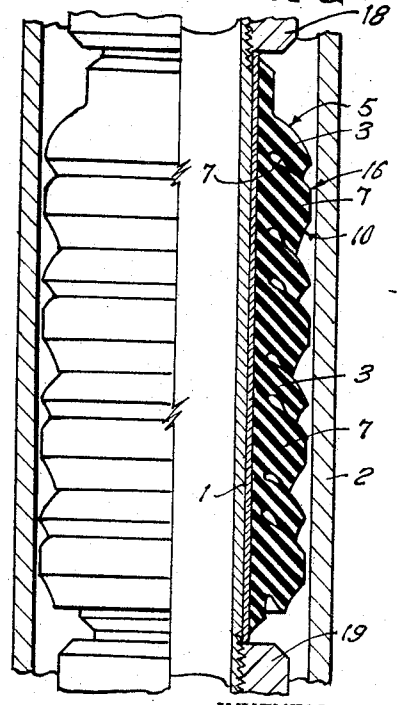


Fig. IV

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WELL SWAB DEVICE

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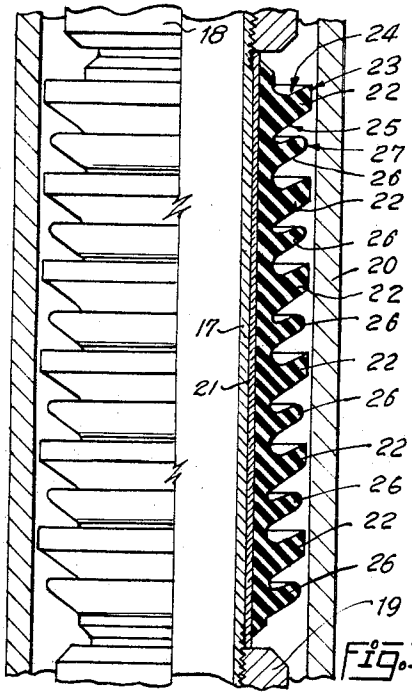


Fig. V

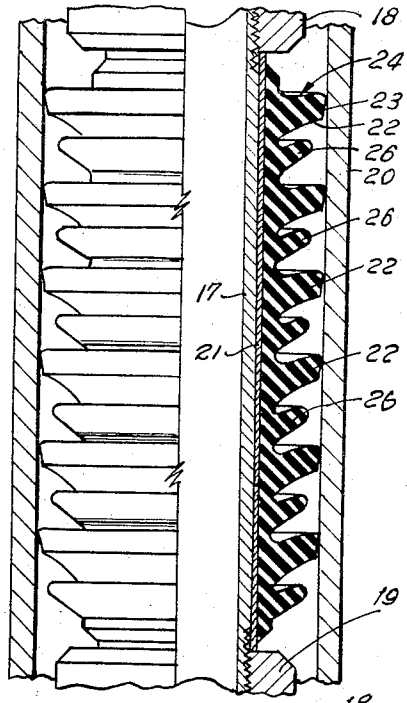


Fig. VI

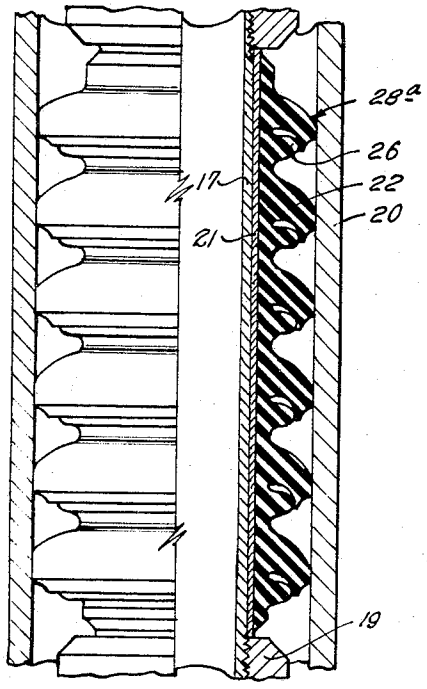


Fig. VII

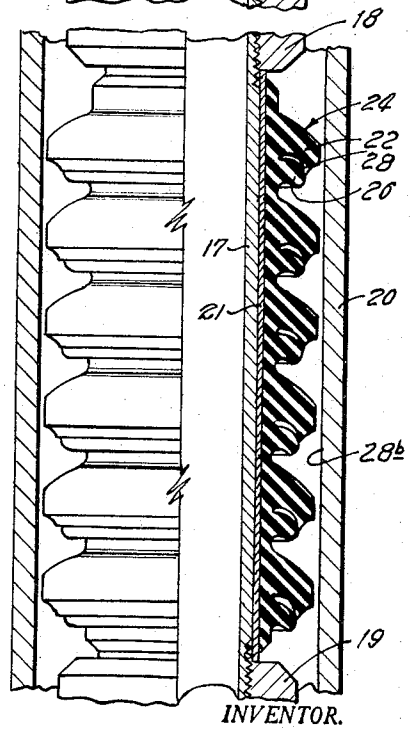


Fig. VIII

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WELL SWAB DEVICE

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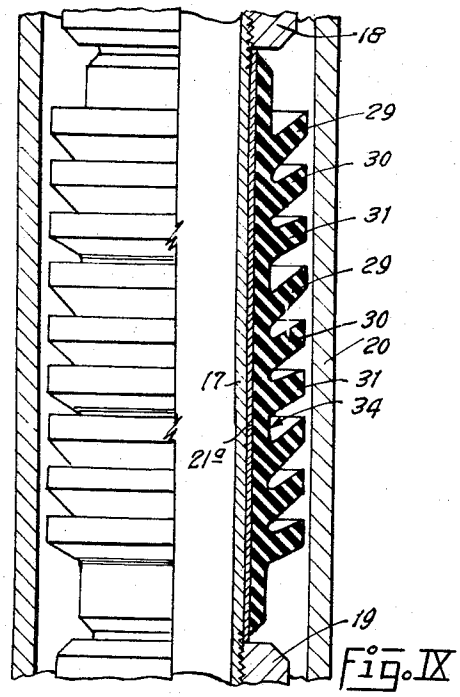


Fig. IX

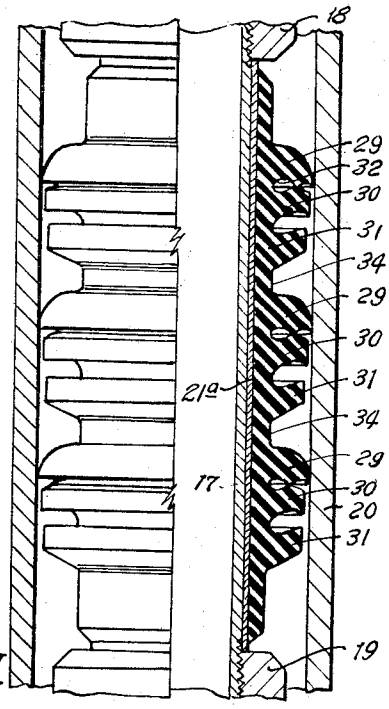


Fig. X

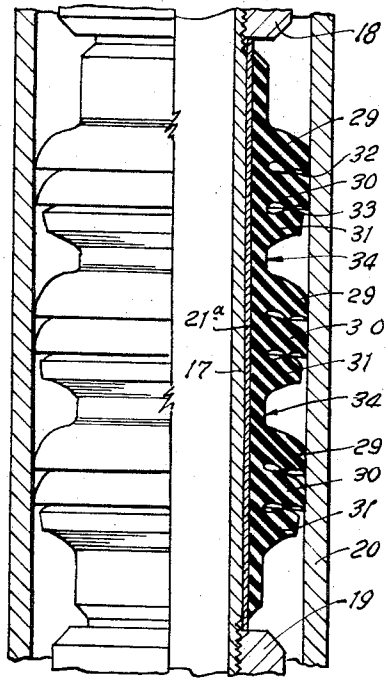


Fig. XI

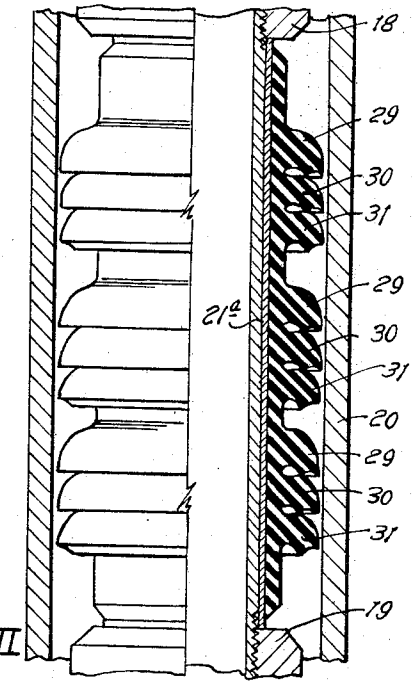


Fig. XII

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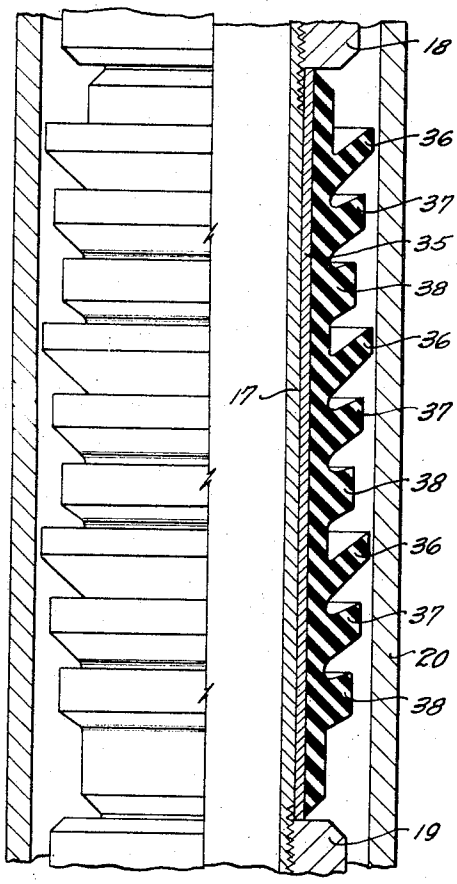


Fig. XIII

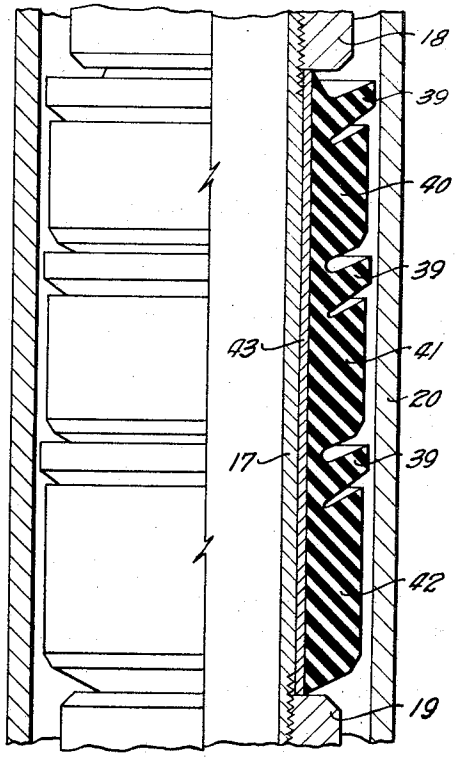


Fig. XIV

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United States Patent Office 3,352,212
Patented Nov. 14, 1967

3,352,212

WELL SWAB DEVICE

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Filed May 3, 1962, Ser. No. 192,229
9 Claims. (Cl. 92—192)

ABSTRACT OF THE DISCLOSURE

A well swab seal including a metal tubular support with rubber seal and support flanges molded thereabout. The flanges are shown as being of varying lengths, angles and numbers. The support flanges support the sealing lip to cause it to support more fluid. This abstract should not be construed to limit the disclosure or the scope of the claims.

This invention has to do with a seal device for lifting fluid upwardly through a pipe in an oil or gas well, and is particularly concerned with that type of seal device arranged to be attached to a well swab, and having sealing rings or flanges disposed thereabout, and spaced therealong, to seal against the inner wall of a well pipe as it is withdrawn from the well to lift fluid upwardly through the pipe.

The seal device to which the improvements disclosed and claimed herein are addressed, is of the type comprising a plurality of unreinforced rings or flanges molded in spaced relationship about a tubular support, wherein the flexible sealing rings or flanges are arranged to project upwardly at an angle from the support, and are arranged to flex downwardly under a load of fluid disposed thereabove into sealing relationship to the inner wall of the pipe, and which may be arranged to flex further downwardly in response to a predetermined load of fluid to allow the by-pass of fluid about the edges of the flexible sealing flanges, to dump the excess load.

A common defect in such swab sealing devices of the type hereinabove indicated is that the flexible sealing units or rings are spaced apart so that they each fold downwardly to seal, and to by-pass fluid independently of each other, and are not supported from below, so that all of the flexible flanges have a tendency to move downwardly to by-pass position simultaneously, and the fact that they are not supported from below renders them unduly responsive to fluid pressure from above to the extent that only a very limited load of fluid can be lifted from the well at a single run of the swab into the well.

It is the primary object of this invention to provide a swab seal device having a multiplicity of seal rings molded or integral on a common tubular bushing, which seal rings are arranged to move downwardly to seal against the wall of the pipe, and may move further downwardly in response to differential in pressure thereacross to allow by-pass of fluid, but which provides for lifting a greater load of fluid and longer life than previous seal devices of the same general type.

Another object of the invention is to provide a swab seal device having a multiplicity of flanges or seals molded on a common bushing, and having outwardly projecting flange-like support rings or flanges molded on the bushing interspersed between the sealing flanges wherein the supports are of lesser diameter than the sealing rings and so spaced from the sealing rings that the sealing rings come into contact therewith when they fold over to sealing and/or by-pass position, so that the support rings back up the sealing rings to add greater strength thereto, to thereby carry a greater load.

Still another object of the invention is to provide a

multiple flange swab seal member having alternate seal rings and support rings, wherein the seal rings may be fewer in number on a given support and more flexible, so that the swab seal will fall easier through fluid and the seal rings may be made more flexible, so that the swab may be lowered through rough points in the tubing, such as off-set joints and paraffin deposits.

A still further object of the invention is to provide in a multiple winged swab seal member means for distributing the wear on the seal rings by reason of progressive wear points on the sealing surface, dependent on the pressure differential applied thereacross, to thereby prolong the life of the seal member.

Another object of the invention is to provide a multiple flanged, integral, swab seal device, wherein the resilient seal rings thereon are supported and backed up by resilient support rings, so that the seal rings may be made more flexible and more responsive to pressure differential to move to sealing position, and wherein the pressure above the seal rings is transferred to the support rings which back up the seal rings, to provide for pulling a greater load of fluid from the well.

Still another object of the invention is to provide in a multiple ringed, unreinforced swab seal device wherein a greater load can be removed from the well with fewer cups per swab assembly.

Another object of the invention is to provide a multiple winged swab seal device which is responsive to pick up a small load of fluid, yet when moved to sealing position the individual seal rings are supported by flexible support rings to such an extent as to bring out a greater load of fluid, thereby providing for picking up a wider range of loads than has been heretofore provided by swab seal devices of the same general type.

A still further object of the invention is to provide a swab seal device having a multiplicity of flexible seal rings thereon which are unreinforced and have the advantage of more ready removability from the well without sticking or hanging, and yet will pull a greater load of fluid thereabove.

Another object of the invention is to provide in a multiple flanged seal member of the type herein indicated, bracing ribs or flanges beneath the sealing flanges which are made of resilient material to resiliently support the sealing flanges when moved to sealing position, but providing a resilient spring effect to move the sealing flanges back to operating position after being inverted, to thereby prevent permanent deformation of the sealing flanges.

A further object of the invention is to provide in a multi-rib swab sealing device sets of three ribs spaced longitudinally of the sealing device, wherein each set of three ribs consists of spaced ribs which are progressively disposed at a lesser angle to the support from the topmost rib down, are progressively thicker from the topmost rib down, and are progressively shorter from the topmost rib down, whereby the upper rib will pick up very light loads, the middle rib will pick up a heavier load, and the lowermost rib will pick up a still heavier load, thereby providing selective load pickup by the ribs, and at the same time providing for progressive support for the sealing ribs from the topmost down, thereby providing for picking up a very light load to a very heavy load, yet allowing by-pass of excessive load to prevent hanging or sticking of the swab.

Another object of the invention is to provide in a multi-rib swab sealing device sets of three sealing ribs spaced along the body, wherein the ribs are progressively less flexible, shorter, and thicker from the topmost rib down, wherein the upper rib will seal under moderate loads and is supported by the middle rib, so that the upper

rib will function as the seal until a certain amount of the rubber thereon is worn away, preventing it from folding downward far enough to seal, allowing the second rib to contact the pipe and provide a seal until it is in turn worn away, at which time the lower rib will act to provide a seal; thereby providing for sequential wear distribution from the uppermost rib downward, thus providing for longer life of the sealing member.

Other and further objects of the invention will become apparent upon reading the detailed specification hereinafter following, and by referring to the drawings annexed hereto.

Suitable embodiments of the invention are shown in the attached drawings, in which:

FIGURE I is a quarter-sectional, elevational view of one form of the improved swab sealing member mounted upon a swab support, as it would appear while being lowered into the tubing;

FIGURE II is a quarter-sectional, elevational view of the swab sealing member, shown in FIGURE I, as it would appear in relationship to the tubing under a relatively light load of fluid;

FIGURE III is a quarter-sectional, elevational view of the swab seal member shown in FIGURE I, as it would appear in relationship to the tubing under a heavy load of fluid;

FIGURE IV is a quarter-sectional, elevational view of the swab sealing member, shown in FIGURE I, as it would appear in relationship to the tubing while it is allowing excess fluid load to by-pass same;

FIGURE V is a quarter-sectional, elevational view of an alternate form of the improved swab sealing member mounted on a swab support as it would appear while being lowered into a tubing;

FIGURE VI is a quarter-sectional, elevational view of the swab sealing member, shown in FIGURE V, as it would appear in relationship to the tubing under a relatively light load of fluid.

FIGURE VII is a quarter-sectional, elevational view of the swab sealing member, shown in FIGURE V, as it would appear in relationship to the tubing under a relatively heavy load of fluid;

FIGURE VIII is a quarter-sectional, elevational view of the swab sealing member, shown in FIGURE V, as it would appear in relationship to the tubing while allowing by-pass of excess load of fluid thereabout;

FIGURE IX is a quarter-sectional, elevational view of still another alternate form of the improved swab sealing member, as it would appear in relationship to the tubing while being lowered into the tubing;

FIGURE X is a quarter-sectional, elevational view of a swab sealing member, made in accordance with the sealing member shown in FIGURE IX, as it would appear in relationship to the tubing while under relatively light load of fluid;

FIGURE XI is a quarter-sectional, elevational view of a swab sealing member made in accordance with the alternate form of FIGURE IX, as it would appear in relationship to the tubing under a relatively heavy load of fluid; and

FIGURE XII is a quarter-sectional, elevational view of a swab sealing member made in accordance with the alternate form shown in FIGURE IX, as it would appear in relationship to the tubing while by-passing excessive fluid loads thereabout.

FIGURE XIII is a quarter-sectional, elevational view of another form of swab sealing member, as it would appear in relationship to the tubing while being lowered into the tubing.

FIGURE XIV is a quarter-sectional elevational view of still another form of swab sealing member as it would appear in relationship to the tubing while being lowered into the tubing.

Numeral references are employed to indicate the various parts shown in the drawings, and like numerals indicate like parts throughout the various figures of the drawings.

Referring to the form shown in FIGURES I–IV, the numeral **1** indicates a metallic or other rigid tubular bushing about which is molded a sleeve **2** of resilient elastic material, such as natural or synthetic rubber compound.

The sleeve **2** is molded to provide a plurality of upwardly projecting, alternate elastic flanges **3** and **7**. The flanges **3** are relatively thin as compared with the flanges **7**.

Each resilient flange **3** includes a straight end surface **4** parallel to the axis of the bushing **1** in normal relaxed position, an angularly disposed upper surface **5**, and an angularly disposed lower surface **6**. The lower surface **6** is disposed at a lesser angle with relation to the axis of the bushing **1** than the angle of the surface **5** with relation to the said axis. Thus the flanges **3** are somewhat wedge-shaped in that they are narrower at their outer ends than at their inner ends.

It will further be observed that the flanges **7** are relatively thicker than the flanges **3**, and includes an outer face **8** thereon parallel to the axis of the bushing **1**, and an angular upper surface **9** which extends upwardly and outwardly therefrom. The outer face **8** terminates in an angularly disposed surface **10**, which merges into an outwardly angled lower surface **11**.

It will also be noted that the flanges **7** are less in overall diameter than the flanges **3** for the purposes which will be hereinafter mentioned.

The swab seal member hereinbefore described may be mounted upon a tubular swab mandrel **17**, which may have threadedly attached at its upper end a conventional float valve cage **18** and at its lower end a base nut **19**. However, it will be understood that the swab seal member may be detachably attached about any conventional form of swab seal support, such as a solid swab mandrel, for lowering into a well.

As shown in FIGURE I, it will be noted that the outer edges of the flanges **3** and **7** are spaced from the inner wall of the tubing **20**, and as shown, same are in the position with relationship to the inner wall of the tubing string as they would appear while being lowered into a column of fluid in the tubing string.

Normally the sealing flanges **3** would be made of a diameter slightly less than the interior diameter of the tubing **20**, but due to the flexibility of the sealing flanges **3** the said sealing flanges will normally cup upwardly while being lowered through a column of fluid to allow a greater clearance between the edges of the sealing flanges and the inner wall of the tubing to allow free by-pass of fluid thereabout.

As shown in FIGURE II, when the sealing member is raised in the tubing **20** under a load of fluid disposed thereabove, the ball check valve (not shown) in the valve cage **18**, if such is employed, closes by reason of pressure of fluid thereabove, and the fluid load is caught on the sealing flanges **3**.

Under a moderately light load of fluid, the sealing flanges **3** would flex and fold downwardly to sealing engagement with the inner wall of the tubing string, as indicated at **12**, and would thus raise a relatively light load of fluid thereabove as the ends of the sealing flanges **3** slide along the inner wall of the tubing **20**. It will be noted in FIGURE II that the support flange **7** have not been distorted in any manner by the light load of fluid being raised by the sealing flanges **3**.

Upon being placed under a heavier load of fluid, the sealing flanges **3** would flex and move further downwardly past a horizontal plane projected therethrough, thus exposing a greater area of the upper surface of the sealing flanges to the inner wall of the tubing string, thereby enabling same to have wider sealing contact with the inner wall of the tubing and raise a heavier load thereabove. Upon being subjected to a still heavier load, the

sealing flanges 3 would flex and move further downwardly into engagement with the support flanges, as shown on FIGURE III, to thereby support and reinforce the sealing flanges 3 to allow same to lift an even heavier load. Further loading of the flanges 3 will cause the load to be transmitted to the support flanges 7, causing same to flex and flow downwardly and expand outwardly into sealing engagement with the inner wall of the tubing as indicated at 14.

When the upper surfaces of both the sealing flanges 3 and 7 are in sealing engagement with the inner wall of the tubing, the swab sealing device is under maximum loading. As the load increases, the sealing flanges 7 will flow and expand downwardly to such an extent as to come into contact with the next adjacent sealing flanges 3, to provide continuous support for the sealing flanges throughout the lengths of the swab sealing member.

However, it will be observed in FIGURE IV that in the event an excessive load is encountered which is more than the combined strength of all the sealing and support flanges 3 and 7 can support, the said flanges will flex and flow downwardly, sufficiently to provide a space 16 between the inner wall of the tubing 20 and the outer edges of the sealing flanges 3 and 7 to allow the by-pass of the excessive load of fluid. After the excessive load of fluid has been by-passed, the sealing flanges will move back to sealing position, as shown in FIGURE III.

Therefore, it will be seen that the form shown in FIGURES I–IV provides a swab sealing member having flexible, normally upwardly projecting flange elements thereon, which are unreinforced and capable of being flexed downwardly to sealing position, and further downwardly to allow by-pass of excessive load of fluid, but which are stronger and will carry a greater load of fluid than sealing members heretofore provided having individual elastice flanges thereon, which were separately and individually operable.

In the embodiment shown in FIGURES I–IV, a very light load can be carried by the sealing flanges 3, but a very heavy load can be carried by the combined sealing and supporting effect of the flanges 3 and 7 by reason of the engagement of the various sealing flanges to support each other, which in effect provides a solid unreinforced rubber member having sufficient flexibility by reason of spaces provided therebetween, to permit same to flex downwardly sufficient to by-pass excessive fluid load, thereby preventing the swab from sticking and hanging in the well tubing as a result of excessive fluid load.

It will further be seen that the wear is distributed between the sealing flanges 3 and 7, and that normally relatively light loads would be carried by the sealing flanges 3, that the sealing flanges 7 are only operable as sealing members when heavy loads are encountered, and that on relatively light loads the thicker, stronger, yet shorter flanges 7, act as support back-up members for the more flexible sealing flanges 3.

In FIGURES V–VIII, there is shown an alternate form of swab seal member involving the principle of back-up support flanges for sealing flanges, wherein the support flanges are relatively thinner and shorter than those shown in the preferred form of FIGURES I–IV, so that the sealing member of the alternate form of FIGURES V–VIII is relatively more flexible for carrying over-all lighter loads of fluid and allowing overload by-pass at lesser loads. This provides an intermediate type of swab cup of the general type described and claimed herein, but which has the advantage of providing a resilient support for the sealing flanges so that they will carry a heavier load with fewer sealing flanges which are more flexible, thereby allowing faster drop of the swab, and easier passage through restrictions in the pipe, and further assuring that the sealing flanges will spring back to normal, undistorted position when pressure is released therefrom.

In the embodiment shown in FIGURES V–VIII, a

tubular support bushing 21 is provided which is slidably disposed over the tubular mandrels 17 of the swab support, in the manner hereinbefore described.

Pairs of alternate resilient seal flanges 22 and support ribs 26 are integrally molded in spaced relationship on the outer side of the bushing 21.

The seal flanges 22 are angularly disposed upwardly, and have straight ends 23 thereon which are parallel to the longitudinal axis of the bushing 21.

Each sealing flange 22 is provided with an angular upper face 24, and an angular lower face 25 thereon, which is disposed at a greater angle relative to the longitudinal axis of the bushing 21 than the angular disposition of the upper surface 24.

The ribs 26 are spaced from the sealing flanges 22 and are likewise angularly disposed upwardly, and are thicker at their inner edges than the outer edges. The outer edges of the ribs 26 are rounded, as indicated at 27, but it will be understood that they could be flat and still perform the same function. It will further be noted that the over-all diameter of each rib 26 is considerably less than the overall diameter of the flanges 22. It will further be observed that considerably wider spaces are provided between the pairs of flanges 22 and ribs 26 than the spaces between the respective flanges 22 and ribs 26 in each pair.

Under relatively light loads of fluid, it will be observed in FIGURE VI that the sealing flanges 22 flex and bend over with the outer edges thereof in sealing contact with the inner wall of the pipe 20, to thereby provide a seal to carry a relatively light load of fluid.

Upon encountering a heavier load of fluid, the sealing flanges 22 would flex further downwardly, as shown in FIGURE VII, causing the upper, outer edges of the sealing flanges to contact and sealingly engage the inner wall of the tubing 20. It will be noted that in this position, the sealing flanges 22 also bend over into engagement with the ribs 26. Thereby the ribs 26 provide a back-up support for the sealing flanges 22, causing the sealing surfaces, indicated at 28*a*, to be pressed against, and impinge against, the inner surface of the pipe 20 to thereby provide for the lifting of a heavier load of fluid than would be the case if the sealing flanges 22 were not backed up and supported by the ribs 26.

Upon being subjected to a greater load than the flanges 22 and the ribs 26 are designed to support, the pairs of flanges and ribs will fold and elastically flow downwardly to provide an annular by-pass area 28*b* between the inner wall of the well tubing 20 and the edges of the flanges 22, to thereby allow the excess load of fluid to by-pass the ends of the flanges 22 until the excess load is released, at which time the built-in resiliency of the material of the flanges 22 and support ribs 26 cause the flanges 22 to move upwardly to sealing position against the inner wall of the tubing 20 as shown in FIGURE VII, to bring the load of fluid up the tubing thereabove. Upon being removed from the pipe, or under no load, the flanges 22 and ribs 26 will return to normal undistorted position.

The resilient effect of the ribs 26, assures that the flanges 22 will move back to sealing position immediately upon release of the excess load of fluid, and prevents the sealing flanges 22 from remaining downwardly out of sealing position by reason of permanent deformation caused by being subjected to excessive load of fluid. Furthermore, the springy resilient supporting effect of the ribs 26 assures a firm sealing engagement of the sealing surfaces of the flanges 22 with the inner wall of the tubing, even though the sealing surface may be progressively worn away. This effect is also attained with the form shown in FIGS. I–IV.

Another advantage of the constructions shown in FIGURES I–IV and FIGURES V–VIII is that by providing the relatively short support ribs or flanges alternately between the sealing flanges, relatively fewer sealing flanges may be provided on a given support and the sealing flanges may be made thinner and more flexible

by reason of the back-up supports thereunder. This permits the swab to fall faster through a column of fluid in the pipe by reason of the sealing flanges being more easily flexed upwardly to allow by-pass of fluid thereabout, and also permits the more flexible, fewer sealing flanges to be moved downwardly through restrictions in the well tubing, such as joints, and salt or paraffin deposits. This uni-directional support for the ribs, which may be fewer in number and are more flexible, provides for a freerer falling swab, yet by reason of the back-up support ribs or flanges provides a swab with better swabbing capability, capable of carrying a heavier load than would be the case if such support ribs or flanges were not provided.

Still another alternate form of swab seal support of the type hereinbefore indicated is disclosed in FIGURES IX–XII. In this form the advantages of back-up support flanges in a multi-wing swab seal device, which has the capability of lifting a greater load of fluid, yet is more flexible to allow free-falling, and which is unreinforced so that it will not become lodged in the tubing, are retained.

This last indicated alternate form has the added advantage of providing in such a sealing member with back-up support flanges, a plurality of sets of the sealing and back-up flanges, wherein the sealing and back-up flanges progressively seal against the wall of the pipe, dependent upon the load imposed thereabove, to distribute the wear on the flanges in each section, thereby permitting a range of loads from a very light load to a very heavy load to be lifted by the swab element. Such arrangement further prolongs the life of a given seal member and permits the use of fewer sealing units on a given swab mandrel.

As shown in FIGURE IX, the swab sealing unit comprises a metallic or other rigid tubular bushing **21***a*, to which is integrally molded a plurality of resilient swab flange units, each unit being made up of three flanges **29**, **30** and **31**.

The top flange **29** in each unit has a relatively high angle with relation to the support, the second flange **30** in each unit has a lower angle, and the third flange in each unit has a still lower angle than the flanges **29** and **30**. Furthermore, the flanges **30** and **31** are progressively thicker than the top flange **29**. Therefore, it will be apparent that by reason of the difference in upwardly projecting angle of the flange **29**, **30** and **31** in each unit, the flange **29** is longer than the flange **30**, and the flange **30** is longer than the flange **31**. Therefore, it will be observed that the top flange **29** has the highest angle with relation to the base, and is thinner and more flexible; the intermediate flange **30** is of medium length, is projected upwardly at lesser angle with reference to the base **19**, is thicker and has medium flexibility; and that the lower flange **31** is the shortest in length, is projected upwardly at a still lesser angle with reference to the base **19**, is thickest and has the least flexibility.

Therefore, it will be noted in FIGURE X that the upper flange **29**, being longer and more flexible, will fold over to sealing position against the inner wall of the tubing **20** to provide a seal under even a very light load of fluid, and when so folded over the end thereof comes to rest on the upper surface of the intermediate flange **30** and is supported thereby, to bring the fluid upwardly in the pipe. The contact between the end of the ribs **29** and the upper surface of the rib **30** is indicated at **32**.

It will further be observed from FIGURE XI that upon being subjected to a heavier load of fluid above the flanges, the intermediate flange **30**, which also provides support for the upper flange **29**, is flexed and folded over into sealing position against the inner wall of the tubing **20**, and the outer edge thereof comes into contact with the upper surface of the last flange **31** in each section, so that the upper and intermediate flanges **29** and **30** are supported by the last flange **31** to assure that the load which these flanges will carry will be maintained and supported thereby.

Upon being subjected to a still greater load of fluid, the last flange **31** will flex and fold over to a sealing position against the inner wall of the pipe so that all flanges in each section are in sealing position against the inner wall of the pipe, to bring the heavier load out of the pipe.

Upon being subjected to a greater load than all flanges **29**, **30** and **31** can support, the flanges will flex downwardly to a position shown in FIGURE XII, wherein an annular by-pass area is provided between the edges of the flanges and the inner wall of the pipe **20**, to allow the by-pass of fluid overload.

When the excess load of fluid has been by-passed, the flexibility of the ribs **30** and **31** will progressively move the ribs back into sealing position with the pipe to bring the load out of the well.

It will be observed that under relatively light loads only the upper rib **29** is in sealing frictional contact with the inner wall of the pipe, so that all wear is taken thereby. However, when the sealing surface of the rib **29** is worn away, the second rib **30** will take up the load so that there is progressive wear on the ribs as they are worn away, thereby prolonging the life of the individual swab sealing units. At the same time, the swab sealing unit will carry a greater load of fluid by reason of the contacting relationship between the individual ribs in each unit as they fold over.

In the form of the swab sealing device shown in FIGURE XIII, there are three sets of resilient sealing and support flanges molded about the tubular bushing **35**. The upper sealing flange **36** in each set is longer and turned upwardly at a less angle with relationship to the axis of the support **35** than the support flange **37** immediately therebelow. The support flange **37** is thicker than the sealing flange **36**. The support flange **37** is shorter and extends upwardly at a lesser angle to the axis of the support **35** than the lowermost support flange **38**. The support flange **38** is also thicker than the support flange **37**.

In operation the seal flanges **36** of FIGURE XIII will bend downwardly in response to a load of fluid thereabove, and the upper outer surface thereof will contact and seal against the inner wall of the tubing. The sealing flange **36** will contact, and be resiliently supported by, the support flange **37**, which is thicker and less flexible than the sealing flange **36**. Normally the outer edge of the sealing flange **36** will extend downwardly over the upper, outer edge of the sealing flange **37** as the flange **37** bends downwardly, and in the event an excessive load of fluid is encountered, the support flange **37** will bend further downwardly against the support flange **38**. In this form of device the sealing flange **36** will not normally by-pass fluid because it is firmly supported by the thicker, less flexible sealing flanges **37** and **38** which are progressively shorter and thicker in a downward direction, but in the event that an excessive load of fluid is encountered, or if an obstruction is encountered in the tubing, the sealing flange **36** and support flanges **37** and **38** will flex sufficiently to by-pass the excess load of fluid or allow the sealing device to pass the obstructions without damage thereto.

In FIGURE XIV is shown a variation of the form of sealing device shown in FIGURE XIII. In this form three sets of sealing and support flanges **39**, **40**, **41** and **42** are molded about a tubular bushing **43**, wherein there is only one support flange in each of the three sets of sealing and support flanges. However, it will be observed that the sealing flange extends upwardly and at a less angle to the axis of the support **43**, than the support flanges **40**, **41** and **42**. It will further be observed that the support flange (**40**, **41** or **42**) in each of the three sets of flanges and supports, is shorter and thicker than the sealing flange immediately thereabove, and that the support flanges **40**, **41** and **42** are progressively thicker from the topmost down.

In the operation of the form of sealing device shown in FIGURE XIV, when a load of fluid is imposed thereabove, the top sealing flange **39** would first move downwardly to allow the upper outer edge thereof to seal against the wall of the tubing and in such position it would be supported by the support flange **40** therebelow. Upon an increase in the fluid load above the sealing device, the sealing flange **39** would move downwardly and inwardly enough to allow pressure of fluid thereabove to by-pass same, and move the second sealing flange **39** into sealing engagement with the tubing which would in turn be supported by the support flange **41**. Further excessive load imposed above the sealing element would allow fluid pressure to by-pass the uppermost and middle sealing flanges **39** and cause the lowermost sealing flange to move into sealing engagement with the tubing string and would be supported by the lowermost support **42**.

It is not contemplated in normal use that sufficient pressure would ever be imposed above the sealing device of FIGURE XIV to allow fluid to by-pass the sealing member, but of course the flexible sealing and support flanges could be deformed to pass over obstructions in the tubing to prevent the sealing member from becoming stuck in the tubing by reason of encountering such obstructions.

It will thus be seen that there has been provided a swab sealing unit with a multiplicity of unreinforced upwardly projecting resilient flanges thereon, wherein the flanges are so arranged with relationship to each other and in units so that the flanges may be brought into contacting relationship when folded over to sealing position so that sealing flanges are resiliently supported, whereby a greater load of fluid can be lifted and whereby the uppermost flange will be moved back to sealing position or normal undistorted position after being flexed downwardly to by-pass position by reason of the flexibility of the support flanges or ribs, and wherein the sealing flanges are spaced further apart, are fewer in number and more flexible to provide a freer falling swab. There has also been provided in such a multiple flanged swab sealing element groups of flanges which are progressively shorter, of less upwardly projecting angulation, and graduated in thickness and strength so that they will not only provide support for the uppermost sealing flanges, but will provide for progressive wear on the flanges from the top down, thereby providing for not only lifting a greater load of fluid, but providing for longer life in a given swab sealing unit.

Having described my invention, I claim:

1. In a swab sealing device,

a support;

a plurality of upwardly projecting resilient flanges attached to the support;

the said flanges being progressively projected upwardly at a lesser angle to the axis of the support, and are progressively longer and less in radial width from the topmost down.

2. In a swab sealing device, a tubular support; a plurality of upwardly projecting resilient flange-like sealing members molded about the support; a plurality of support flanges of resilient material molded about the support under each of the sealing flanges; the said support flanges being shorter, thicker and less resilient than the sealing flanges and support flanges in each group are the sealing flanges come into contact therewith when flexed downwardly thereover, and the sealing flanges and support flanges are arranged in groups of three.

3. The combination called for in claim **2** wherein the sealing flanges and support flanges in each group are progressively projected upwardly at a lesser angle with relation to the axis of the support, and are progressively longer and less in radial width from the topmost down.

4. The combination called for in claim **2** wherein the sealing flanges and support flanges in each group are progressively projected upwardly at a lesser angle with relation to the axis of the support, and are progressively longer and less in radial width from the topmost down; and the support flanges are progressively thicker from the topmost down.

5. In a swab sealing device, a tubular support; an upwardly projecting resilient sealing flange attached to the support; a plurality of upwardly projecting resilient support flanges attached to the support underneath the sealing flange, the support flanges being less in radial width than the sealing flange and progressively longer from the topmost down.

6. In a swab sealing device, a tubular support; a plurality of upwardly projecting resilient sealing flanges attached to the support; an upwardly projecting resilient support flange attached to the support underneath each sealing flange; the support flanges being less in radial width than the sealing flanges and being progressively longer from the topmost down.

7. The combination called for in claim **6** wherein the sealing flanges are projected upwardly at a lesser angle to the axis of the support than the support flanges.

8. In a swab sealing device, a tubular support, an upwardly projecting resilient sealing flange attached to the support; a plurality of upwardly projecting resilient support flanges attached to the support underneath the sealing flange, the support flanges being progressively longer from the topmost down.

9. In a swab sealing device, a tubular support, a plurality of upwardly projecting resilient sealing flanges attached to the support; an upwardly projecting resilient support flange attached to the support underneath each sealing flange; the support flanges being progressively longer from the topmost down.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,352,212 Dated November 14, 1967

Inventor(s) Norman W. Read

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 10, line 1, delete "support flanges in each group are" and in lieu thereof insert -- being so spaced therebetween, that --

SIGNED AND
SEALED
SEP 15 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents