Jan. 28, 1964 J. A. HALL 3,119,451

CEMENT BASKET

Filed Jan. 9, 1961 4 Sheets-Sheet 1

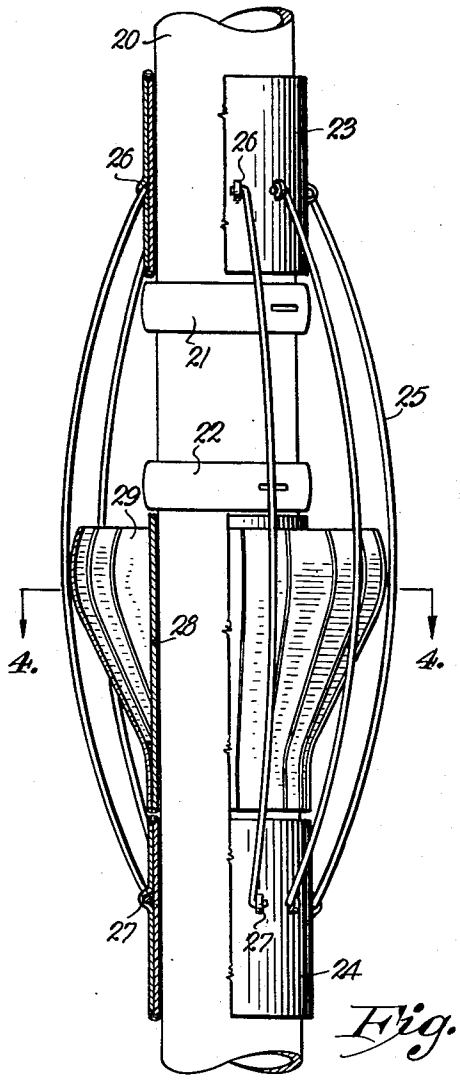



Fig. 1.

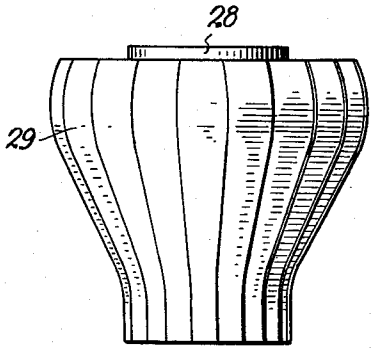



Fig. 2.

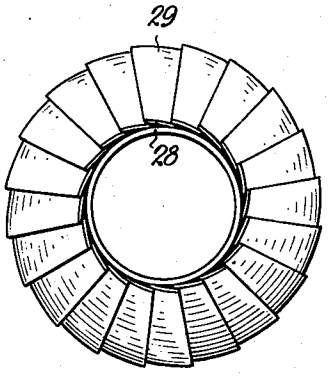



Fig. 3.

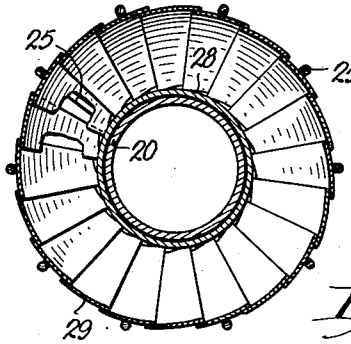



Fig. 4.

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CEMENT BASKET

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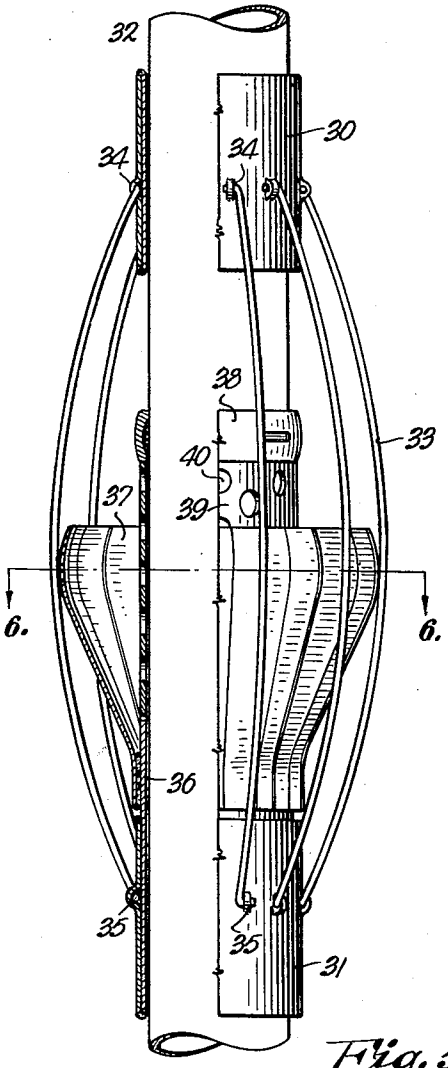



Fig. 5.

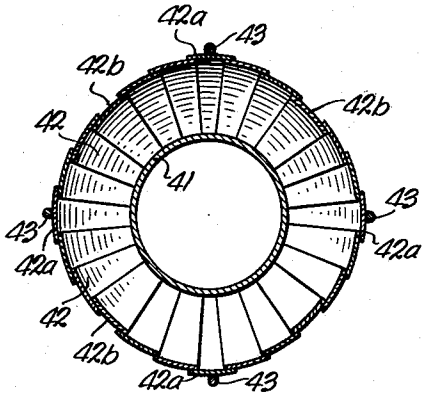



Fig. 7.

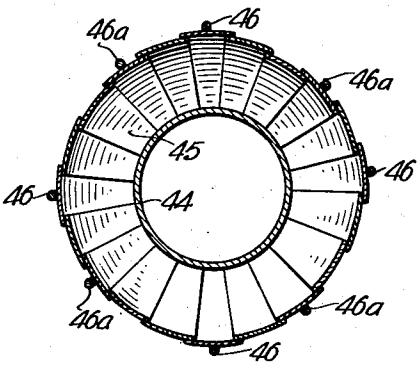



Fig. 8.

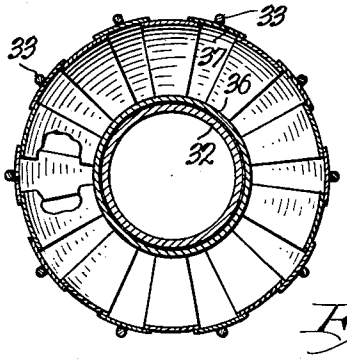



Fig. 6.

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CEMENT BASKET

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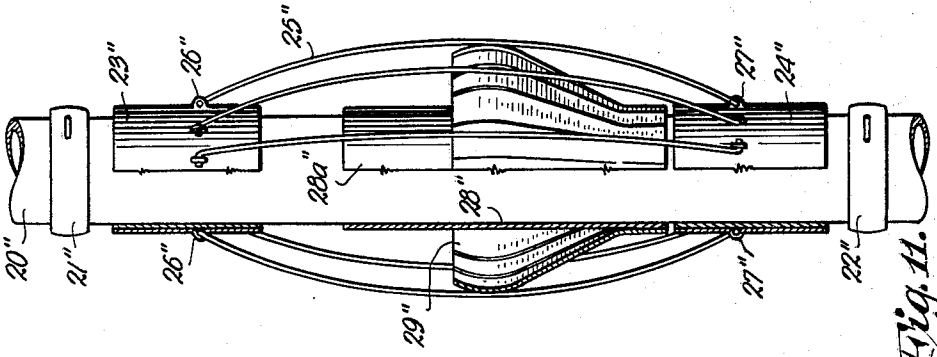



Fig. 11.

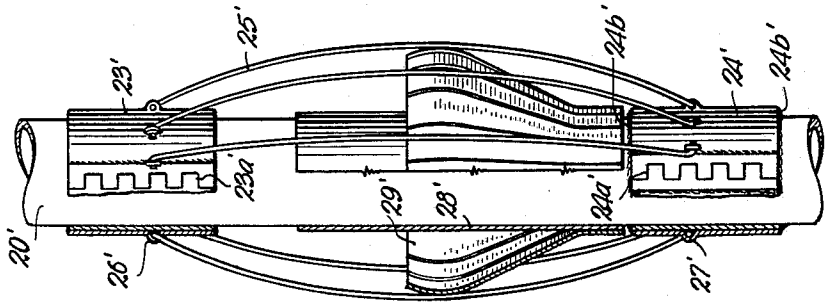



Fig. 10.

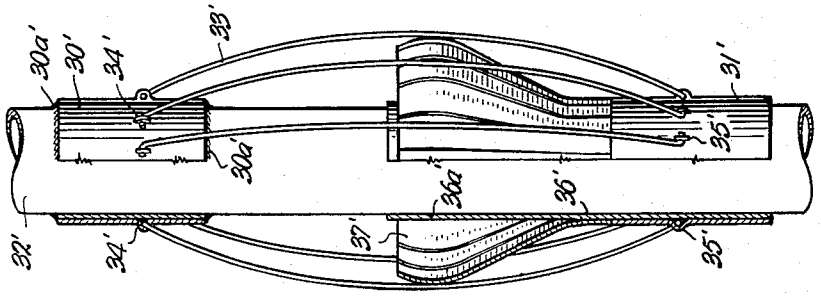



Fig. 9.

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CEMENT BASKET

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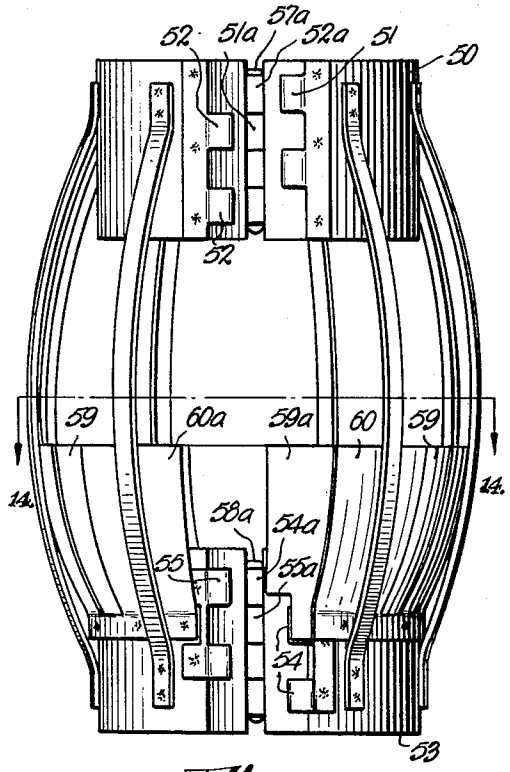



Fig. 12.

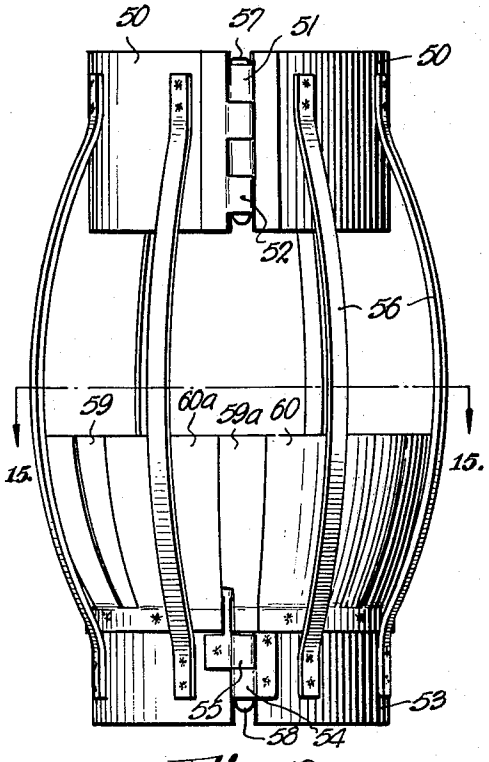



Fig. 13.

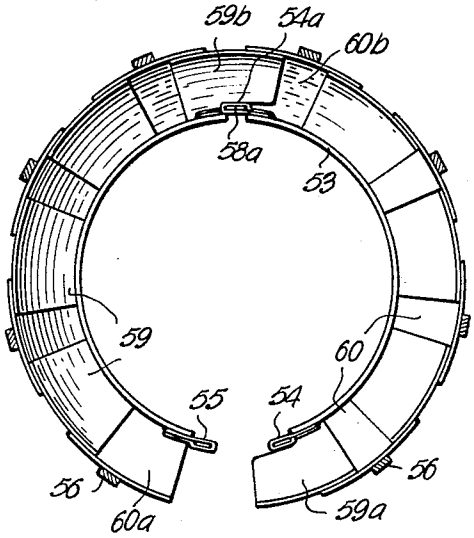



Fig. 14.

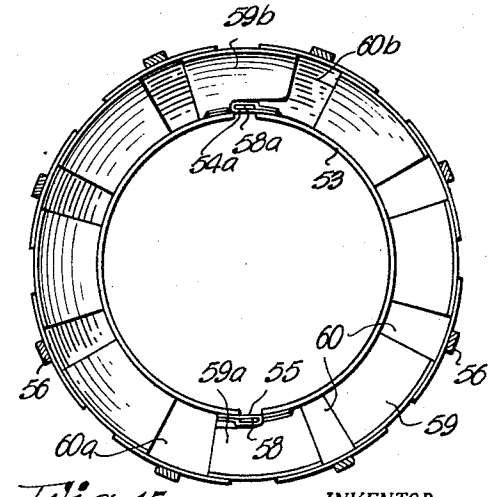



Fig. 15.

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United States Patent Office 3,119,451 Patented Jan. 28, 1964



3,119,451

# CEMENT BASKET

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Filed Jan. 9, 1961, Ser. No. 81,640
25 Claims. (Cl. 166—202)

This invention relates to new and useful improvements in cement baskets for oil wells and refers more particularly to a cement basket which is mountable on a casing and serves both to center the casing during drilling operations and provides a one directional obstruction in the well bore annulus during cementing to position the cemented-off zone.

The invention is an improvement over the construction shown in the patent to J. E. Hall, No. 2,392,145, "Cement Basket" issued January 1, 1946, and is a continuation-in-part of my application Serial No. 748,192, entitled "Cement Basket" filed July 14, 1958, and now abandoned.

The cement basket has many uses in well drilling and well completion. In water wells, it is used as a formation catcher employed above a screen liner to prevent plugging of the screen and to bridge off surface waters above. Sometimes slushings, earth, cement or the like are poured in on top of the basket as a plugging agent in such water wells. Cement baskets are sometimes used on a screen liner in oil, gas, water and sulphur wells to stop settling of loose formation down the annulus around the screen. Baskets are also used to cement off blank sections spaced within a perforated or screen liner. In such use, one basket is placed near the bottom of the blank section and another may be placed at the top of the blank, each basket opening upwardly. Cement is then circulated through a port above the bottom basket up through the annulus to or near the top basket.

Cement baskets may be used on surface or on conductor casing to centralize the casing, spread cement, deflect cement against the well bore, and hold the cement in place both while it is setting up and after it has set up. In the latter instance, if drilling through the casing should shatter the cement, as sometimes happens, and cement falls down the hole, such a basket will block passage of the cement down into the open hole, thus avoiding a loose and unsupported casing. Baskets are employed on screen liners in oil and gas wells to stop any sloughing of formation from the well walls at the level of the basket.

The art is cognizant of two basic types of conventional baskets. The first consists of loose springs extending from a collar upwardly. Such a basket has been the most commonly used, but it has a serious drawback and disadvantage in that it will often be torn up if the pipe should be picked up while being run into the hole.

The second type of conventional basket (see the Hall patent, supra), will not tear up if the casing is picked up because it possesses a row of flat housing springs which run from the bottom collar of the basket up and out over the top thereof and connect back into an upper collar mounted on the casing. Such housing springs prevent the Hall basket from being torn up when being moved up and down in the well bore. However, the broad housing springs of the Hall structure take up far too much space in the well bore annulus. The excessive breadth of the Hall outer housing springs and narrow inner leaves thereof often cause trapping of formation and loss circulation materials beneath them, thus producing a chocking or blocking off effect which results in clogging both the outside and the inside of the basket, thereby restricting or blocking off the circulation in the well bore annulus. Such latter restriction sometimes causes the formation to break down below the basket, resulting in a lost circulation condition. The problem of circulating past the Hall



basket has caused its use to be limited to wells with clean mud, little sloughing of formation, and small quantities of lost circulation material. Where there are further possibilities of circulation stoppage or blockage with a cement basket in a well that is likely to lose circulation under even normal pumping conditions, it is very dangerous to use such a basket.

Therefore, an object of my invention is to provide a cement basket which will effectively center the casing during drilling operations and also serve as an effective one-way obstruction during cementing operations.

Another object of my invention is to provide a cement basket which operates as an effective casing centralizer and an effective one-way cement obstruction yet offers a minimum obstruction in the well bore annulus to proper flow of cement past the basket.

Another object of my invention is to provide a cement basket which is an effective casing centralizer, an effective one-way cement obstruction in the well bore annulus, and offers a minimum obstruction of the well bore annulus to proper flow of cement past the basket, yet is so constructed as to not be destroyed by reciprocating motion of the casing in the well bore.

Another object of my invention is to provide a cement basket of outwardly extending, resilient, free-end strips, which strips are completely retained and adequately protected by an outer cage of fixed-end strips, the latter yet offering a minimum obstruction in the well bore annulus.

Another object of my invention is to provide a cement basket which effectively centers the casing in the well bore and performs all the desired functions of a cement basket yet has a minimum obstruction to one-way flow of cement through the well bore annulus, the centralizing elements being of variable form and shape yet effectively protecting the cement basket proper.

Another object of my invention is to provide a cement basket which permits the employment of higher viscosity mud in the well bore annulus without undue restriction from housing springs.

Another object of my invention is to provide a cement basket which operates to clean itself in the well bore and better reinforces cement setting in the well bore annulus.

Yet another object of my invention is to provide a cement basket wherein the cement basket proper may be freely mounted within its protective centralizer.

Another object of my invention is to provide a cement basket which is still an effective centralizer when the basket springs are compressed inwardly by fluids, cuttings, sloughings, etc. circulating past it.

Another object of my invention is to provide a cement basket wherein it is not necessary for the outer row, or cage, of centralizing springs to compress or deflect when allowing the basket-forming-inner-springs to compress inwardly to permit circulation, cuttings, etc. to move past it in the direction of the nonbasket end of the assembly.

Another object of my invention is to provide a cement basket collar-leaf unit which may be incorporated into almost any conventional lace-on type centralizer of suitable size to form a complete operating cement basket.

Yet another object of my invention is to provide a cement basket which may be attached to or mounted on a well casing in a great variety of ways.

Another object of my invention is to provide a cement basket which can also be used as a junk catcher on a bailer or on a sinker on a cable, or on a drill tubing for fishing and removal from the hole of unwanted extraneous material or foreign bodies, or for straining such material from the circulation flow.

Another object of my invention is to provide a cement basket which may be used as a circulation aid in pumping fluid up the annulus.

Yet another object of my invention is to provide a cement basket which is not limited to use in only a straight centralizer, but may be used also in a spiral centralizer, in any S-bow or zigzag bow centralizer or yet additionally may be used in a multiply-bowed centralizer positioned within any one of the multiple bows.

Still another object of my invention is to provide a cement basket which can be used in close tolerance holes (by elimination of the extra collar beneath the basket springs).

Another object of my invention is to provide a cement basket which can slide between casing collars or stops a sufficient distance without being torn up or distorted when the casing is picked up, the basket standing relatively still when the casing is picked up.

Another object of my invention is to provide a cement basket which will cooperate with the outer springs of the centralizer therearound so as to inwardly close the leaves of the basket when the top of the basket springs move against the inwardly formed portion of the centralizer springs.

Yet another object of my invention is to provide a lace-on cement basket.

Other and further objects will appear in the course of the following description thereof.

In the drawings, which form a part of the instant specification and are to be read in conjunction therewith, embodiments of the invention are shown and, in the various views, like numerals are employed to indicate like parts.

FIG. 1 is a side view with parts cut away of a first form of the inventive cement basket (free basket in centralizer).

FIG. 2 is a side view of the cement basket proper of FIG. 1 before mounting on the casing.

FIG. 3 is a view of the construction of FIG. 2 in bottom plan.

FIG. 4 is a view taken along the line **4—4** of FIG. 1 in the direction of the arrows.

FIG. 5 is a side, partially cut away view of a second form of the inventive cement basket (fixed basket in centralizer).

FIG. 6 is a view taken along the line **6—6** of FIG. 5 in the direction of the arrows.

FIG. 7 is a top-sectional view of a third form of the inventive cement basket illustrating a different arrangement of the free-end strips thereof.

FIG. 8 is a top-sectional view of a fourth form of the inventive cement basket illustrating yet another arrangement of the free-end strips thereof.

FIG. 9 is a side view with parts cut away of a cement basket identical to that shown in FIG. 5, differing therefrom only in the manner of mounting of the basket on the well casing and the length of the collar within the cement basket leaves.

FIG. 10 is side view parts cut away of a cement basket identical in construction to that shown in FIG. 1, except that the centralizer thereof is a lace-on type, the basket is mounted by different means on the well casing and the basket proper collar is of somewhat different length.

FIG. 11 is a basket identical in all ways to that of FIG. 1 with the exception that it is mounted in a different manner on the well casing and the collar of the cement basket proper is of somewhat different length.

FIG. 12 is a side elevation of an integral lace-on cement basket construction partly opened on one side thereof.

FIG. 13 is a side elevation of the basket of FIG. 12 fully closed.

FIG. 14 is a view taken along the line **14—14** of FIG. 12 in the direction of the arrows.

FIG. 15 is a view taken along the line **15—15** of FIG. 13 in the direction of the arrows.

FIGS. 1, 10 and 11, generally described, disclose cement basket subunits adapted to float more or less free within a confining centralizer unit. Various means of attachment or mounting of these unit assemblages on the casings are shown. FIGS. 5, 9 and 12–15, inclusive, show cement basket assemblages with the cement basket subunit therein, fixed relative to the centralizer subunits. FIGS. 2–4, inclusive, show a cement basket subunit particularly adapted to ride free within a centralizer subunit, as in FIGS. 1, 10 and 11, or useful alone on a casing between stops under certain circumstances. FIGS. 6–8, inclusive, show leaf patterns of cement basket subunits best adapted for use fixed in a centralizer as in FIGS. 5, 9 and 12–15, inclusive. FIG. 10 also shows the use of a lace-on centralizer. FIGS. 12–15, inclusive, show a lace-on integral cement basket assembly, including basket and centralizer units. The particular showings will now be specifically described.



Referring first to FIG. 1, therein is shown a modification of the invention in which a free-floating cement basket (collar and basket strips secured thereto) is confined within a centralizer mounted on a casing **20**.

The operation of the baskets will be described relative each particular modification.

Two conventional stop collars **21** and **22** are fixedly mounted on casing **20**. The centralizer portion of the cement basket assembly is formed with upper and lower centralizer collars **23** and **24** connected by a plurality of out-bowed flexible strips, rods or wires **25**. The ends of the rods **25** are secured to the collars by engagement within lugs **26** and **27** on the upper and lower collars, respectively, or by riveting or welding to the collars. The fixed end rods **25** preferably are round in cross section.

A third collar or basket **28** has a plurality of flexible, out-bowed, free-end basket strips **29** secured at one end to the outside surface thereof by welding or brazing, the upper free ends of strips **29** increasing in width toward their upper ends and curved slightly inwardly adjacent their upper ends to a lesser outside radius than their greatest outside radius intermediate their ends. Free-end strips **29** are preferably of a length substantially one-half the distance between the upper and lower collars **23** and **24** and not substantially greater than this distance. However, it may be desirable to have them substantially less or greater than one-half the distance if the hole conditions or centralizer design dictate it.

FIG. 4 shows the necessary overlying relationship between the free-end strips to permit the third collar **28** on the casing **20** to be one which freely rotates thereon inside of the centralizer. The length of collar **28** is preferably at least equal to or slightly greater than the length of strips **29**. For the cement basket with overlapping adjacent strips to properly function as a free-floating unit within the fixed end rods **25**, each free-end strip, in fully expanded position, must partially overlie one adjacent free-end strip and be partially overlaid on the other side thereof by the other adjacent free-end strip. The rods **25** must be spaced apart, one from the other, a distance so that when one rod overlies one free-end strip in the fully expanded position of the basket, the rods adjacent thereto will each overlie at least one other free-end strip. A preferred arrangement is shown in FIGS. 1 and 4 with adjacent rods **25** overlying every other free-end strip when any one rod overlies one free-end strip. An operable arrangement is possible relative the overlying pattern of FIG. 4 with adjacent rods **25** overlying each third or fourth free-end strip, but the rod arrangement of FIG. 4 is preferable, as each free-end strip is then either directly braced by a rod **25** or overlaid partly by a free-end strip that is reinforced by such a rod. The width of the free-end strips adjacent their upper ends must be sufficient that, when the free-end strips lie against the rods **25** circumferentially, the strips **29** yet overlie one another as in FIG. 4.

Free-end strips **29** are curved in cross section substantially throughout the length of their contact as shown in FIG. 4, but are relatively flat in cross section adjacent their attached lower ends as shown in FIG. 3. The flatter cross-sectional portions of the strips provide greater resiliency for spreading or out-bowing of the strips and the

more curved cross-sectional portions provide reinforcement and stiffening of the strips above the resilient portions. When expanded, the basket is normally at least as large as the maximum diameter of the well bore.

In operation, when the casing and basket are lowered into the well, the basket contracts when passing through constricted portions of the well bore, that is, collars 23 and 24 slide apart on the casing and the bowed portions of strips or rods 25 move toward the casing. The basket holds the casing properly centered in the well bore so that cement injected into the annular space below the basket will flow properly around the casing, above and into the basket to form a receptacle and obstruction for the cement to base an impermeable cement plug thereabove. When circulation materials flow against the bottom of the basket, the inner springs fold inwardly, leaving wide gaps for easy passage of fluids between the outer round springs 25. When circulation is stopped, the outward tension of the inner springs causes them to spring back against the supporting housing springs. While circulation may force all of the free-end springs inwardly toward the casing, the outer springs still center the casing and thus permit wide spaces between the well bore wall and the free-end springs for the free passage of fluid which may include cuttings, sloughings and lost circulation materials.

In the modification of FIGS. 1–4, wherein the basket is shown as free-floating within the cage of fixed-end springs 25, each free-end spring supports the spring next to it in the basket portion. However, the final support is provided by the fixed end springs. The purpose of the third collar or bumper 28 is to prevent the leaves or free-end springs 29 from striking the stop collars 21 or 22 or the casing itself if other securement means are employed during reciprocation of the casing. Thus, the length of the collar 28 is preferably slightly greater than the length of the free-end springs 29 in their expanded position and at least substantially equal to their length in pushed-in position.

The cement basket body proper which is shown separately in FIG. 2, can be installed in any "lace-on" centralizer (with openable hinged collars) in the field or in any solid or closed-type centralizer in the shop. If desired, once the assembly is mounted on the well casing, the top of collar 28 may be welded or otherwise fixed to stop collar 22. Alternatively, prior to mounting of the assembly on the casing, the end of the collar 28 receiving the expandable leaves 29 thereon may be welded or otherwise fixed, either in the shop or in the field, to the inner end of collar 24 whereby to be integral therewith. If the latter is the case, the intermediate stop collar 22 need not be employed and the centralizer and cement basket assembly may reciprocate the distance from the lower end of collar 23 (or inner end thereof) to the inner end of collar 28 relative to the stop collar 21.

FIGS. 10 and 11 show cement baskets of identical function and structure to that of FIGS. 1–4, with a few minor exceptions. Therefore, in FIG. 10, parts identical with the parts of FIGS. 1–4 are numbered the same, but primed. Additional numerals are added in FIG. 10 to indicate the novel portions thereof. In FIG. 11, parts identical therein to parts of FIGS. 1–4 are numbered the same, but in this case double primed. Additional numerals are added for parts not found in FIGS. 1–4 in the assembly. No duplicate description will be made of the identical parts between FIGS. 10 and 11 and FIGS. 1–4, inclusive, save where different operation or function requires such.

Referring specifically to FIG. 10, a first difference in this showing from that of FIGS. 1–4, inclusive, comprises the provision of band end connectors on the centralizer collars 23′ and 24′ whereby to make the centralizer a "lace-on" type, that is, the collar splits into two parts whereby to be able to be fitted around the casing and then secured thereon, rather than slid thereon. The lace or band end connection shown is conventional and is that illustrated in Patent 2,666,241, Hall, Sr., issued January 19, 1954 "Band End Connection." Therefore, the details of this connection will not be repeated here, it being understood that any other conventional band end construction would suffice. A like connection is on the other side of the casing from that shown for each collar whereby to permit the splitting of each collar into two parts. The lace connection is generally indicated on collar 24′ at 24*a*′ and for collar 23′ at 23*a*′. The third collar 28′ may itself be split for suitable reassembly by conventional band end connections or by welding on the casing, but this is not shown. When such is the case, the cement basket may be first assembled on the casing, then the centralizer therearound. If the centralizer itself is the only one which may be opened, the cement basket collar 28′ must first be slid on the casing, then the centralizer laced thereover.

A second distinction between FIG. 10 and FIG. 1 lies in the fact that, instead of the provision of stop collars 21 and 22, lower collar 24′ is welded as at 24*b*′ to the casing 20′, thereby fixing collar 24′ on the casing. Collar 23′ remains free to slide on the casing, as does third collar 28′, the latter free to rotate within the centralizer springs 25′ and relative to fixed collar 24′. Any other conventional means of fixing collar 24′ on the casing will serve the same effect and permit the functional operation of the cement basket in the manner previously described.

However, when the cement basket is fixed to the casing by the fixing of one of the centralizer collars relative thereto, it is preferred that third collar or basket collar 28′ be elongated more than the collar of FIG. 1 whereby to prevent the third collar running up close to the top collar 23′ and wedging the cement basket leaves 29′ close against the casing under centralizer wires 25′. The length of the extension 28*a*′ preferably is at least twice the distance from the tops of the leaves 29′ to the lower extremity of collar 23′ when the lower extremity of collar 28′ abuts the upper extremity of collar 24′. When this is the case, leaves 29′ cannot become so closed as to not open by filling from above to perform the cement basket function.

Referring to FIG. 11, this showing particularly illustrates another way of fixing the cement basket assembly on the well casing 20″. FIG. 10 shows the fixing of one centralizer collar to the casing (the lower), with a free cement basket sub-unit in the centralizer sub-unit. Alternatively, the upper collar 23′ of FIG. 10 could have been welded or otherwise fixed to the casing 20′ leaving collar 24′ free on the casing to slide thereon. In such latter case, the extension 28*a*′ would also preferably be present, although not necessarily, for the identical reasons set forth relative to FIG. 10.

In FIG. 11, on the other hand, while there is shown a free third collar 28″, relative to both of the centralizer collars 23″ and 24″, the latter two collars are also free on the casing 20″ with additionally no stop means such as 21 and 22 in FIG. 1 between the centralizer collars. Stop means here are provided in the form of stop collars 21″ and 22″ positioned above and below collars 23″ and 24″, respectively. These collars must be positioned a greater distance apart than the distance between the extremities of collars 23″ and 24″ in normal position whereby to permit compression of the centralizer springs 25″ and basket leaves 29″ with corresponding forcing apart of the collars 23″ and 24″.

With this minimum spacing, a maximum spacing might well contemplate and I so disclose their spacing where the basket can slide the entire length of a pipe joint between collars 21″ and 22″ whereby, in casing reciprocation, after bumping of the plug in cementing jobs, the sliding action can be equal to the reciprocating stroke. This permits reciprocation after the plug is bumped and after the cement cake wall has grown into the periphery

of the cement basket, thus forming a pump liner seal with the basket. Spacings intermediate between these two extremes are feasible, depending upon the effect and operation desired.

Since the cement basket of FIG. 11 involves a basket sub-unit free relative to the centralizer collars 23'' and 24'', an extension of the same type as 28*a*' is provided as at 28*a*'' whereby to maintain the basket leaves properly oriented and ready for operation within the centralizer springs 25''. This latter extension is not necessary, save in certain operations, but insures proper operation at all times.

Referring now to FIGS. 5–6, therein is shown a modification of the invention wherein the cement basket proper must be integral with its centralizer or at least the collar and basket strips thereof fixed relative to the centralizer lower collar. At 30 and 31 are shown the upper and lower collars of the centralizer which slidably fit on the casing 32. Out-bowed, fixed-end strips or rods or wires 33 are fixed at each end thereof to the collars 31 and 32 by lugs 34 and 35 or by welding or riveting. Collars 31 and 30 and rods 33 are of the same character as collars 23 and 24 and rods 25 previously discussed relative to FIG. 1.

A third collar 36 is fixedly attached to collar 31 by welding or other conventional means or made integral therewith in the process of manufacture of collar 31. A plurality of resilient, out-bowed, free-ended strips 37 are fixed at one end to collar 36. Alternatively the strips may be welded to the top of the lower centralizer collar or to the outside surface thereof or made integral therewith. The length of the strips 37 is preferably substantially half the distance between the inner edges of collars 30 and 31 and the free ends preferably turn inwardly adjacent their ends. Collar 36 is of the same inside diameter as collar 31 so as to slide on the casing 32 readily.

A single stop collar 38 of conventional type may be rigidly attached to the outer surface of casing 32 and preferably has sleeve 39 welded or otherwise fixedly attached thereto between collar 38 and the collar 36. Sleeve 39 alternatively may slide freely on the casing. Perforations 40 are evenly spaced over the surface of sleeve 39. Sleeve 39 must be of such length that it will abut collar 36 before the ends of strips 37 reach the collar 38 in either expanded or inwardly pressed position. Thus the entire cement basket and centralizer assembly is free to reciprocate on the casing between the limits of collar 30 abutting stop collar 38 and collar 36 striking the lower end of sleeve 39. The purpose of the perforations 40 in the collar or sleeve 39 is to aid in preventing bridging of the cement and aid in permitting cement to replace mud against and/or beneath the collar or sleeve 39.

Referring to FIG. 9, therein is shown a cement basket which is basically identical to that shown in FIG. 5, with certain minor modifications relating to the manner of mounting same on the well bore casing. Therefore, all parts identical to parts in FIG. 5 of the structure shown in FIG. 9 are numbered the same, but primed. These identical parts will not again be described.

Turning to the modifications or changes or differences between the construction in FIG. 9 relative to that of FIG. 5, the means for securing the position of the cement basket on the casing 32' comprise welding or otherwise fixedly attaching the upper collar 30' to the casing as shown at 30*a*'. No securement is made of the lower collar 31'. Since the collar 36' is integral with or attached to collar 31', there is no reason to provide any elongate extension thereof in the manner of FIGS. 10 and 11. However, in order to protect the centralizer leaves 37', collar 36' is extended upwardly as at 36*a*' to a height relative to the leaves 37' of the height of collar 28 in FIG. 1 relative to the height of leaves 29.

In operation of the modification of FIG. 9, the basic function is identical as previously described relative the modifications of FIGS. 1 and 5 as a cement basket, the freedom of compression of springs or wires 33', however, being provided by means of the slidability of lower collar 31' on the casing and the position of leaves 37' relative to the wires or rods 33' being taken care of by the integral attachment of collar 36' to the lower collar 31'. All statements relative to the mounting of leaves 37 on or relative to lower collar 31 apply equally to the modification of FIG. 9.

A second arrangement of the resilient strips 37 relative one another is shown in FIG. 6. In this modification, the strips next one another are either completely overlaid by adjacent strips or completely overlie adjacent strips. Thus every other strip is either overlaid by two adjacent strips or overlies two adjacent strips. The rods 33 are spaced so as to overlie other strips 29. The free-end strips 37 taper from a lesser width adjacent their attachment to collar 36 to a greater width adjacent their free ends. The width of the strips must be such that the relationship therebetween is as shown in FIG. 6 when the cement basket is fully expanded. The FIG. 6 arrangement basket strips must be employed fixed relative to the collar of the centralizer as, if the rods 33 overlie only the inside strips, the outer strips would have no support and be free to be torn off if the casing were picked up in the well bore.

FIG. 7 shows an alternative arrangement of the flexible free-end strips in the cement basket. A collar 41 mounts the strips 42, 42*a* and 42*b* or the strips may alternatively be fixed to the lower centralizer collar. Certain strips 42*a* separated by five intermediate strips are positioned outermost of the array of free-end strips while other strips 42*b*, separated by five intermediate outwardly positioned strips are the inner strips. This array may be employed with only four rods 43 overlying the four outermost strips 42*a* as shown in FIG. 7. However, it is preferred to have rods 43 overlying every other strip (not shown) including the outermost strips 42*a*, thus having no rods overlying the innermost strips 42*b*. In the arrangement of FIG. 7, as in the FIG. 6 arrangement, the cement basket strips must be rigidly fixed relative to the centralizer collar.

FIG. 8 shows yet another arrangement of the free-end strips relative one another. Collar 44 mounts the free-end strips 45 or they may be fixed to the lower centralizer collar. The modification of FIG. 8 combines the structures of FIGS. 6 and 7 with adjacent strips other than the outermost strips being both wholly overlaid by adjacent strips or partly overlaid and partly overlying adjacent strips. Like FIG. 7 and FIG. 6, the FIG. 8 modification basket strips must be fixed relative to the centralizer collar.

Either straight round rods, spiral round rods or rods with S-curves may be employed as units 25 and 33. If the casing 32, while cement is being circulated past the springs 33, is picked up faster than the cement is moving, or a distance greater than the centralizer sliding distance, the column of the cement above the leaves 37 will be pumped by the valve action of the basket between the casing and the well bore. Pumping takes place with the FIG. 1 modification on any pickup of the casing due to the fixed centralizer. Some fluid slippage, however, will be present in both cases. Any of the disclosed baskets can thus be employed to pump cement up the hole on conventional cement jobs or pump cement down the hole on reverse cement jobs if they are mounted on the casing so that the stroke is greater than the distance they slide on the casing.

Referring particularly to FIGS. 2–4, inclusive, already described, in the operation of this modification, in addition to that already described, this form may be used free on the casing itself under certain conditions. Thus, to use this form without a surrounding centralizer as op-

posed to the manner of FIGS. 1, 10 and 11, it is necessary that the basket collar 28 be free to slide on the casing between stops placed on the casing as in the manner of stops 21" and 22" in FIG. 11. Such stops must be placed far enough apart on the casing that the casing in the well bore, once it is inserted therein, is not lifted in the well bore a height greater than the distance between the stops. Mounting between stops in this manner permits the casing to be lifted from a lowermost point where the upper portion of collar 28 is against the top stop to an uppermost point where the lower end of collar 28 is against the lowermost stop without the basket itself moving vertically upwardly in the well bore. The latter is the only true hazard to free basket use, namely, where the free-ended leaves are pulled upwardly in the well bore and can catch on obstructions therein and be destroyed. So long as the casing moves downwardly through the well bore and the leaves are free to flex inwardly, the basket will, under any but the most extraordinary conditions, remain intact.

Yet another mode of use of the basket type shown in FIGS. 2–4, inclusive, lies in its mounting on a casing in the maner of FIGS. 1, 10 and 11, that is, free relative to the centralizer collars. However, in a further instance, instead of stop means being provided within the centralizer, or therewithout, or one of the centralizer collars being fixed to the casing, the basket collar 28 is itself fixed to the casing by welding or other fixed attachment, with the centralizer collars themselves free to slide on the casing. If it is desired that the motion of the centralizer collars relative to the cement basket collar 28 be limited whereby to limit the inward folding of the cement basket leaves 29 by the centralizer wires, then the collar 28 needs to be elongated in the manner of collars 28' or 28". Alternatively, if it is desired to make it possible for the cement basket leaves to be essentially closed by the centralizer wires upon reciprocation of the casing in the well bore, the collar 28 is made no longer than that shown in FIG. 2. Thus it may be seen that the relative closure of the cement basket leaves 29 themselves may be controlled in various ways relative to the fluid motion in the well bore annulus between the casing and the well bore wall, depending upon the direction of reciprocation of the casing, that is, up or down, and the direction of mounting of the cement basket collar 28 on the casing, that is, with the basket leaves facing up or down. If desired, in this described modification, one or more stop collars may be employed between the collar 28 and either one of the centralizer collars in order to regulate motion of the centralizer collars and wires relative to the basket leaves, as well.

FIGS. 12–15, inclusive, show an integral cement basket-centralizer assemblage with the cement basket leaves mounted integrally on the lower collar of the centralizer. This basket assembly is a "lace-on" form, which may be fitted around the casing, rather than slid thereon. It should be understood that the lower collar 53 of FIGS. 12–15, inclusive, can be employed with the centralizer wire elements 56 removed therefrom as a free unit in the manner above described relative to FIGS. 2–4, inclusive, thus providing a lace-on, free cement basket, if desired. Additionally, such a free basket leaf carrying collar with the lace-on feature may be employed as an insertion unit in any conventional centralizer with the band end connections disconnected to fit or slide the leaf carrying band between the centralizer wires or bands and then reassembled therewithin. Such a lace-on element could readily be employed with the lace-on centralizer of FIG. 10 to provide a complete lace-on unit. Collar 53 can be extended upwardly to any length desired therewithin in the manner of collars 28, 28', 28", etc. In inserting such a lace-on cement basket within a conventional centralizer without being able to open the latter, only one lace-on side of the lace-on cement basket unit need be opened, thus permitting the twining or intertwining of the cement basket unit one edge forwardly into the centralizer for reassembly therein.

Referring generally to the cement basket assemblies of FIGS. 5, 9 and 12–15, inclusive, therein are shown various ways of fixing the position of the cement basket leaves relative to the lower or one of the centralizer collars. It should be understood that these particular means of fixing are not exclusive or unique in themselves and the concept of fixing the leaves relative to one of the centralizer collars includes ideas of welding the strips to the top end of the centralizer collar, integrally making or forming the leaves at the top or inside edge of the collar during the forming of the collar, such as by stripping or cutting the edges by means of shearing or sawing. Additional rows or another row of leaves may be added, as desired, by laying on individual leaves or a continuous strip with sheared ends and welding in various spaced relationships to the integrally-formed leaves to form baskets as previously described. Other modes and manners of fixing the leaves relative to the lower collar may also be employed, so long as the relationship of the centralizer wires and leaves, as described, are achieved.

In all of the centralizer subunits shown in the instant application, it should be understood that the centralizer strips or wires or bands may be made straight as shown, with S-curves, or zigzag shapes, or the like, so long as the relationships specified to the basket leaves are preserved. The same springs, bands, strips, rods, wires, etc. of the centralizers may be of rectangular, square, oval, etc. cross section or other irregular outline, or of varying cross section, again so long as the relationships specified to the basket leaves and collars are preserved. The material in all cases of the elements of the various cement baskets shown is preferably steel, but may be of suitable alloy or the like so long as equivalent performance is provided.

Referring particularly to FIGS. 12–15, inclusive, therein are shown a pair of centralizer collars 50 and 53, respectively, of the nature of the centralizer collars previously described, whereby to slide freely on a well bore casing. The casing is not shown in the various views or means controlling the basket position thereon in order to better illustrate the lace-on nature of the cement basket assemblage. Collar 50 has two band end connections of more or less conventional type, such as that previously described relative to FIG. 10 or, as shown, involving intermeshing eyes 51 and 52 for one connection and 51*a* and 52*a* in the other connection. Pegs, nails or the like, 57 and 57*a*, are provided to interengage in locking fashion the band end connections to permit opening and closing of the band. As previously mentioned, only one side or both sides of the band may be opened, as required, to lace the assemblage on the casing. Collar 53 likewise has band end connections 54 and 55 joined by nail or peg 58 and band end connections 54*a* and 55*a* joined together by peg or nail 58*a*. Thus both collars may be separated as necessary to lace the cement basket assemblage on the well casing.

A plurality of out-bowed, flexible strips, rods, wires or members 56 connect collars 50 and 53 in a manner previously described relative to the prior modifications, the bands in this case shown spot welded to the outside surfaces of the respective collars.

Spot welded or otherwise fixedly attached to the collar 53 within the centralizer bands 56 are a plurality of overlapping cement basket leaves 59 and 60, the numeral 59 generally designating the inner leaves, with numeral 60 generally desingating the outer leaves. The leaf arrangement is that shown in FIG. 6, although the leaf arrangements shown in any of FIGS. 4, 6, 7 and 8 and any others contemplated by this application are suitable, so long as the centralizer bands 56 are positioned relative thereto as previously described. Leaves 59 and 60 are spot welded or otherwise fixedly attached to the collar 53 and one another in the pattern of FIG. 6 with the bands 56 over-

lying the outer leaves 60 in the manner shown in FIG. 6 and as previously described relative thereto.

A special leaf construction is provided on the inner leaves 59*a* and 59*b* at the band end connections which lie behind the outer leaves 60*a* and 60*b* also at the band end connections. Thus the lower portions of leaves 59*a* and 59*b* are so cut away as to fit over the portion of leaves 60*a* and 60*b* fixed to the collar 53 and lie therebehind when in closed position as in FIG. 15. This provides a complete sealing construction in the integral basket of FIGS. 12–15 to prevent leaks therethrough.

In operation of the form of the invention shown in FIGS. 12–15, inclusive, the basket is laced onto the casing by separation of one or both of the band end connections in both collars 50 and 53, as required. Some means is provided for controlling the sliding of collars 50 and 53 on the casing, in the manner of any of the showings previously described above. If stops are used between collars 50 and 53 as in the manner of FIG. 1, collar 53 must preferably be extended upward vertically as in FIG. 1. A stop and collar arrangement as shown in FIG. 5 is also suitable. It is preferred to have some collar protection for the upper ends of leaves 59 and 60. Stops may be provided on either side of the collars 50 and 53 as in the manner of FIG. 11, spaced greater or lesser distances apart, depending upon the reciprocation of the cement basket unit desired. One or the other of collars 50 and 53 may be fixed to the casing as in the manner of FIGS. 9 or 10. In all other respects, the operation of the basket of FIGS. 12–15, inclusive, is the same as previously described relative to the other modifications, particularly those where the basket leaves are fixed relative to one of the centralizer collars.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. In combination with a well casing, a cement basket and guide comprising, upper and lower collars surrounding the well casing and slidable thereon, out-bowed flexible strips fastened at their extremities to the collars and extending lengthwise of the casing, mounting means for cement basket strips surounding the well casing, slidable thereon and positioned between the upper and lower collars, said mounting means fixed relative to said lower collar, a plurality of upstanding, outbowed, free-ended cement basket strip units anchored to said mounting means, within the fastened, out-bowed strips and extending only a portion of the distance between the upper and lower collars, each said strip unit so positioned relative to adjacent strip units as to overlie in at least some portion thereof at least one adjacent strip unit, each of said flexible strips positioned so as to overlie at least a portion of one of said units, each said strip unit of markedly greater width than said flexible strips, and means for limiting the sliding motion of said cement basket and guide on said casing.

2. Apparatus as in claim 1 wherein the mounting means for the cement basket strips extends within said cement basket strips a distance at least equal to their length.

3. In combination with a well casing, a cement basket and guide, comprising, upper and lower collars surrounding the well casing and slidable thereon, out-bowed flexible strips fastened at their extremities to the collars and extending lengthwise of the casing, mounting means for cement basket strips surrounding the well casing, slidable thereon and positioned between the upper and lower collars, a plurality of upstanding, out-bowed, free-ended cement basket strips anchored to said mounting means, within the fastened, out-bowed strips and extending only a portion of the distance between the upper and lower collars, one of each two adjacent basket strips overlapping in some portion thereof the other, said flexible strips positioned a distance apart from one another so that at least one of each two adjacent fastened strips will always overlie a free end strip overlying a free end strip next thereto, each said basket strip of markedly greater width than each of said flexible strips, and means for limiting the sliding motion of said cement basket and guide on said casing.

4. Apparatus as in claim 3 wherein said mounting means is fixed relative to said lower collar.

5. Apparatus as in claim 3 wherein said mounting means is free relative to said collars.

6. Apparatus as in claim 3 wherein the mounting means for the cement basket strips extends within said cement basket strips a distance at least equal to their length.

7. In combination with a well casing, a cement basket and guide, comprising, upper and lower collars surrounding the well casing and slidable thereon, out-bowed flexible strips fastened at their extremities to the collars and extending lengthwise of the casing, mounting means for cement basket strips surrounding the well casing, slidable thereon and positioned between the upper and lower collars, a plurality of upstanding, out-bowed, free-ended cement basket strips anchored to said mounting means, within the fastened, out-bowed strips and extending only a portion of the distance between the upper and lower collars, one of each two adjacent strips overlapping in some portion thereof the other, said fastened strips spaced apart a distance from one another so that at least one of each two adjacent fastened strips will always overlie a free end strip overlying a free end strip next thereto, and means for limiting the sliding motion of said cement basket and guide on said casing.

8. Apparatus as in claim 7 wherein said mounting means is fixed relative to said lower collar.

9. Apparatus as in claim 7 wherein said mounting means is free relative to said collars.

10. Apparatus as in claim 7 wherein the mounting means for the cement basket strips extends within said cement basket strips a distance at least equal to their length.

11. Apparatus as in claim 7 wherein the mounting means for the said cement basket strips extends within the cement basket strips a distance at least equal to their length and the means for limiting the sliding motion of the cement basket and guide on the casing are positioned between the said mounting means and the upper collar.

12. Apparatus as in claim 7 wherein the width of the free-end strips increases toward their free ends.

13. A cement basket adapted to be employed with separate centralizer means in a cement basket and guide combination comprising a collar adapted to surround a well casing and slide thereon, upstanding, out-bowed, free-end basket strips anchored to said collar, one of each two adjacent basket strips overlying in some portion thereof the other, said collar extending within the free end basket strips a distance at least equal to their length.

14. In combination with a well casing, a cement basket and guide comprising upper and lower collars surrounding the well casing and slidable thereon, out-bowed flexible strips fastened at their extremities to the collars and extending lengthwise of the casing, a third collar surrounding the well casing and slidable thereon positioned between the upper and lower collars, stop means fixed to said casing and positioned between the upper and lower collars, upstanding, out-bowed, free-end strips anchored to the third collar within the fastened out-bowed strips and extending only a portion of the distance between the upper and lower collars, at least one of each two adjacent

free-end strips partly overlying at least one free-end strip next thereto, said fastened strips spaced apart a distance from one another so that at least one of each adjacent fastened strips will always overlie a free-end strip overlying a free-end strip next thereto.

15. Apparatus as in claim 14 wherein the third collar extends within the free-end strips a distance at least equal to their length.

16. Apparatus as in claim 14 wherein the third collar is fixed to the lower collar.

17. Apparatus as in claim 14 wherein the fastened strips are round in cross section.

18. Apparatus as in claim 14 including a stop collar fixed to the casing between the third and upper collars.

19. Apparatus as in claim 18 wherein the third collar is fixed to the stop collar.

20. Apparatus as in claim 14 wherein the width of the fastened strips is less than the width of the free-end strips.

21. Apparatus as in claim 14 wherein the width of the free-end strips increases toward their free ends.

22. In combination with a well casing, a cement basket and guide comprising upper and lower collars surrounding the well casing and slidable thereon, out-bowed flexible strips fastened at their extremities to the collars and extending lengthwise of the casing, a third collar surrounding the well casing and slidable thereon positioned between the upper and lower collars, stop means fixed to said casing and positioned between the upper and lower collars, upstanding, out-bowed, free-end strips anchored to the third collar within the fastened out-bowed strips, and extending only a portion of the distance between the upper and lower collars, at least one of each two adjacent free-end strips partly overlying at least one free-end strip next thereto, said fastened strips spaced apart a distance from one another so that if one of each adjacent fastened strips overlies a free-end strip overlying a free-end strip next thereto, the fastened strip next thereto will also overlie a free-end strip overlying a free-end strip next thereto.

23. In combination with a well casing, a cement basket and guide comprising upper and lower collars surrounding the well casing and slidable thereon, out-bowed flexible strips fastened at their extremities to the collars and extending lengthwise of the casing, a third collar surrounding the well casing and slidable thereon positioned between the upper and lower collars, stop means fixed to said casing and positioned between the upper and lower collars, upstanding, out-bowed, free-end strips anchored to the third collar within the fastened out-bowed strips and extending only a portion of the distance between the upper and lower collars, at least one of each two adjacent free-end strips partly overlying at least two free-end strips next thereto, so that if one of each adjacent fastened strips overlies a free-end strip overlying a free-end strip next thereto, the fastened strip next thereto will also overlie a free-end strip overlying a free-end strip next thereto.

24. In combination with a well casing, a cement basket and guide comprising upper and lower collars surrounding the well casing and slidable thereon, stop means fixed to said casing and positioned between the upper and lower collars, out-bowed flexible strips fastened at their extremities to the collars and extending lengthwise of the casing, a third collar surrounding the well casing and slidable thereon positioned between the upper and lower collars, upstanding, out-bowed, free-end strips anchored to the third collar within the fastened out-bowed strips and extending only a portion of the distance between the upper and lower collars, every free-end strip partly overlying one free-end strip next thereto, said fastened strips spaced apart a distance from one another so that if one of each adjacent fastened strips overlies a free-end strip overlying a free-end strip next thereto, the fastened strip next thereto will also overlie a free-end strip overlying a free-end strip next thereto.

25. Apparatus as in claim 24 wherein said fastened strips are spaced apart a distance from one another substantially equal to the distance between centers of alternate free-end strips at their points of greatest width.

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