Nov. 30, 1954 F. F. SEGESMAN 2,695,820

CARRIER PAD FOR USE IN BOREHOLES

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FIG. 1.

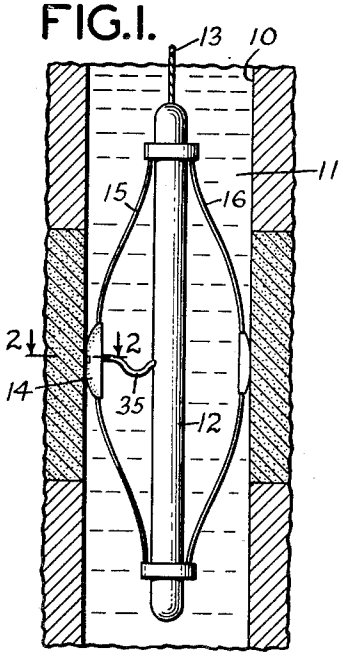

FIG. 4.

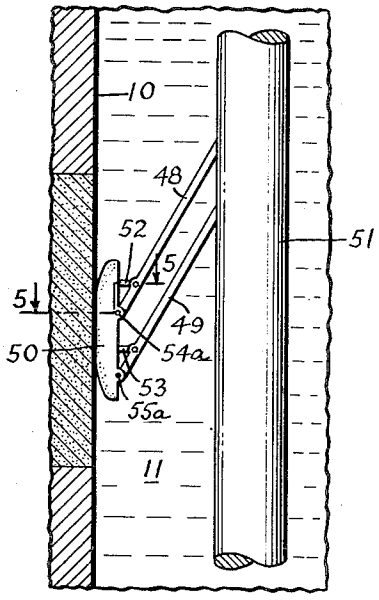

FIG. 2.

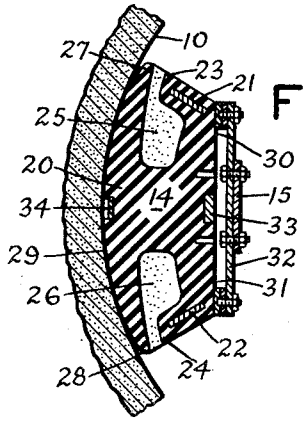

FIG. 3.

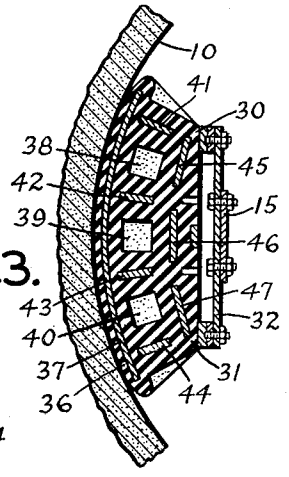

FIG. 5.

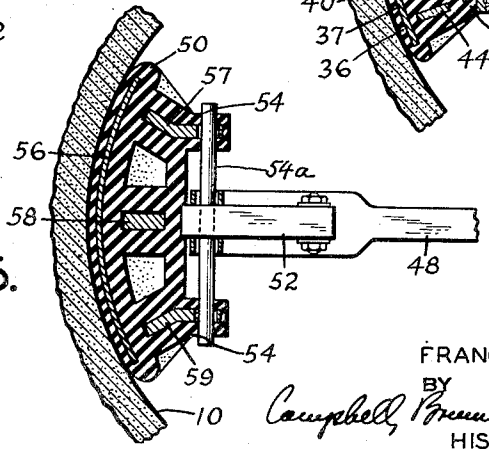

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FIG.6.

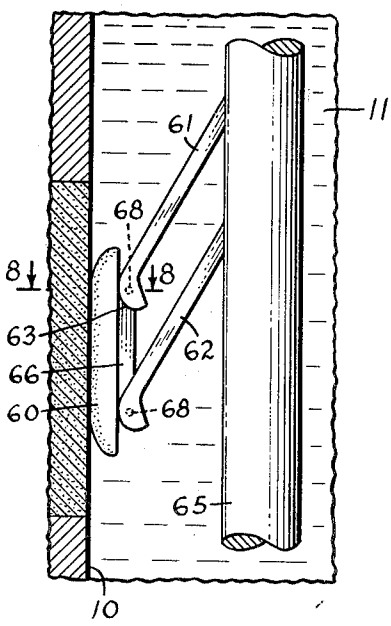


FIG.7.

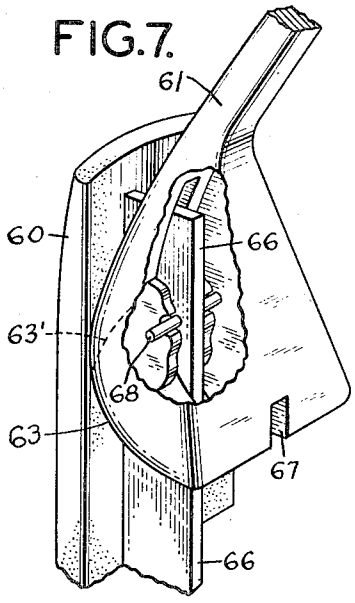
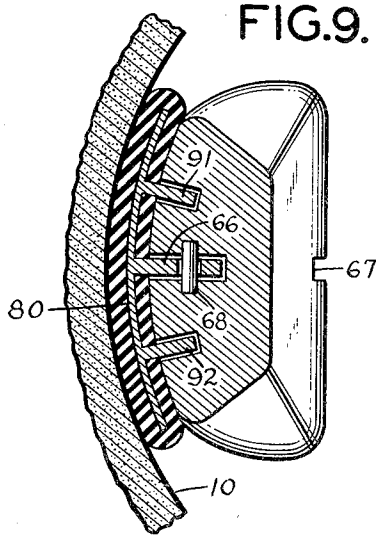


FIG.9.



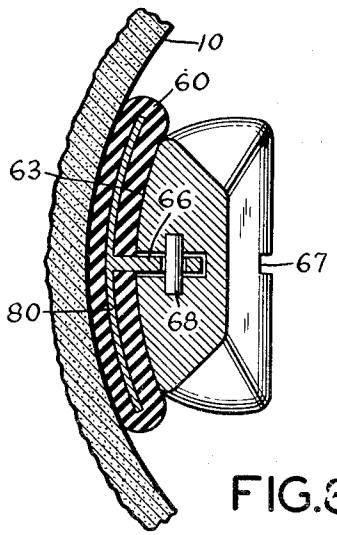


FIG.8.

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CARRIER PAD FOR USE IN BOREHOLES

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Application February 17, 1953, Serial No. 337,273

8 Claims. (Cl. 308—4)

The present invention relates to apparatus for making tests in inaccessible places such as bore holes drilled into the earth, for example, and more specifically to new and improved test equipment carrier means adapted to be lowered into a bore hole and embodying means for continuously maintaining a surface thereof in snug engagement with the side wall of the bore hole for all bore hole diameters within a predetermined range.

Wall engaging carrier means have previously been devised for moving test equipment such as electrodes, coils, radioactivity detectors, probes or the like through a bore hole in fixed relation to the side wall thereof and also for excluding any liquid in the bore hole from the zone between the wall and the test equipment. In general, the prior devices have included a flexible pad member adapted to carry the test equipment and means for urging the pad member into engagement with the wall of the bore hole. While these devices have been effective, they are not entirely satisfactory because the pad members do not always conform effectively to the various wall curvatures encountered in bore holes of different diameters. For example, the contact between the lateral end portions of the pad member and the bore hole wall is sometimes not as good as the contact between the central portion of the pad member and the bore hole wall. As a result, the pad members tend to wear unevenly, the desired relation between the test equipment and the bore hole wall may not be properly maintained and any liquid contained in the bore hole may leak in between the pad member and the bore hole wall and influence adversely the test results sought.

It is an object of the invention, accordingly, to provide new and improved test equipment carrier means for use in bore holes and the like which is free from the above-noted deficiencies of the prior art.

Another object is to provide new and improved carrier means of the above character which embodies means for maintaining a wall engaging surface thereof substantially uniformly in snug engagement with the side wall of a bore hole for all bore hole diameters in a given range.

A further object of the invention is to provide new and improved carrier means of the above character having a bore hole wall engaging surface together with means for adjusting the radius of curvature of said surface as a function of the diameter of the bore hole.

In accordance with the invention, wall engaging means is provided which comprises broadly a flexible pad member having a wall engaging face given a preformed radius of curvature lying in the range of curvatures corresponding to the range of bore hole diameters to be accommodated by the apparatus. In one embodiment, the pad member is adapted to be urged into engagement with the bore hole wall by means which is adapted to exert force against the central portion of the pad member in bore holes having diameters in a lower portion of the range, but is adapted to exert force against the pad member at points spaced laterally about the central portion in bore holes having diameters in an upper portion of the range of bore hole diameters for which the apparatus is designed. The pad member may be provided with reinforcing members to cause the wall engaging surface of the pad member to assume its initial curvature and to aid in transmitting forces to the wall engaging surface so as to urge the latter into snug engagement with the bore hole side wall, regardless of the radius of curvature of the hole so long as it is within the range than can be accommodated by the apparatus.

The invention also contemplates the provision of means for automatically adjusting the forces applied to the pad member as a function of the bore hole diameter so as to maintain the wall engaging surface of the pad member uniformly in engagement with the bore hole side wall.

For a better understanding of the invention, reference is made to the following detailed description of several representative embodiments, taken in conjunction with the accompanying drawings in which:

Fig. 1 is a view in side elevation of wall engaging carrier means, according to the invention, disposed in a bore hole drilled into the earth;

Fig. 2 is a view of the pad member of the apparatus in Fig. 1 in transverse section taken along line 2—2 and looking in the direction of the arrows;

Fig. 3 is also a view in transverse section of a modified form of pad member, according to the invention;

Fig. 4 is a view in side elevation of another form of wall engaging carrier means, according to the invention;

Fig. 5 is a view partly in transverse section of the pad member of the apparatus in Fig. 4 taken along the line 5—5 and looking in the direction of the arrows;

Fig. 6 is a view in side elevation of an alternate modification of the apparatus of Fig. 4, according to the invention;

Fig. 7 is a perspective view of the cam operating means for the pad member of the apparatus shown in the modification in Fig. 6;

Fig. 8 is a view partly in transverse section of the pad member and cam operating means of the apparatus in Fig. 6 taken along the line 8—8 and looking in the direction of the arrows;

Fig. 9 is a view, similar to that of Fig. 8, showing a further modification of the pad member and cam operating means of the apparatus in Fig. 6.

Referring to Fig. 1, there is shown a bore hole **10** containing a drilling mud **11**. In the bore hole **10**, there is disposed a typical logging apparatus comprising an elongated body **12** arranged to be raised or lowered in the well **10** by a cable **13**. A pad member **14** for carrying elements of bore hole apparatus, such as electrodes, for example, may be urged against the bore hole side wall by a bowed spring **15** slidably secured to the body **12** at its upper and lower ends, respectively. In order to maintain the body **12** centered in the bore hole against the bias of the spring **15**, a similar spring **16** may be provided to press against the opposite side wall.

Fig. 2 shows, in transverse section, the pad member **14** of Fig. 1. In accordance with the invention, the pad is composed of a flexible material **20**, such as rubber, for example, and includes two stiffening or reinforcing members **21** and **22** embedded within two lateral edges **23** and **24**, respectively, of the pad and extending radially and longitudinally of the bore hole axis. The members **21** and **22** may comprise elongated rectangular strips of spring steel or a resilient plastic material.

As shown in Fig. 2, the pad includes recessed portions **25** and **26** constructed in such a manner that the ends of the lateral edges **23** and **24** will abut the rear faces of the lateral end portions or side flanges **27** and **28**, respectively, of the wall engaging face **29** of the pad member **14**, when pressure is applied to the rear portions **30** and **31**. The wall engaging face **29** of the pad member **14** has a preformed radius of curvature which preferably lies between the extremes of curvature in the range of bore hole diameters to be accommodated by the apparatus. The spring **15** may be affixed to a backing plate **32**, which is secured to the pad at points **30** and **31** in any suitable manner as by bolts, for example. In the central rear portion of the pad **14**, may be provided a third reinforcing strip **33**. One or more elements of test equipment such as an electrode **34** forming part of a well logging system, may be carried on the wall engaging face **29**, the electrode **34** being connected to one end of an insulated conductor **35** (Fig. 1) leading to the body **12**.

If the preformed or natural radius of curvature of the wall engaging face **29** is less than that of a bore hole in which the apparatus is to be used, the carrier pad **14** may be affixed to the spring **15** by means of the backing plate **32** as shown. With this arrangement, insertion of

the apparatus in the well will cause pressure from the spring **15** to be applied to the points **30** and **31** on the rear portion of the pad member **14** bringing the lateral edges **23** and **24** into engagement with the flanges **27** and **28** of the wall engaging face **29** and urging the latter flanges into engagement with the bore hole wall. The center section of the wall engaging face of the pad will remain in contact with the wall by virtue of the resilient nature of the material **20**.

On the other hand, if the preformed or natural radius of curvature of the wall engaging face **29** is greater than that of the bore hole in which the apparatus is to be used, the backing plate **32** is removed and the spring **15** affixed to the rear central portion of the pad **14** abutting the reinforcing member **33**. Upon insertion of the apparatus in a well, the spring **15** applies pressure along the central portion of the pad **14**, causing the flanges **27** and **28** to flex inwardly towards the lateral edges **23** and **24** until the pad face **29** conforms accurately to the contour of the bore hole wall. When the flanges **27** and **28** abut against the edges **23** an **24**, they will be held firmly against the side wall, although the material **20** is of sufficient resilientcy to permit even further movement if the bore hole diameter is quite small.

It will be appreciated that the features of a relatively thick center portion in the pad **14** and the recessed portions **25** and **26** permit the pad face **29** to conform readily to the wall curvature when the pressure from the spring **15** is applied at the proper points.

In the modification shown in Fig. 3, the wall engaging portion **36** of the pad has embedded therein a broad cylindrical resilient segment of reinforcing material **37** having a preformed radius of curvature. Also, a plurality of recesses **38**, **39** and **40** are formed in the pad **14** to render it more resilient. Between the individual recesses and the adjacent lateral edges of the pad are provided a plurality of longitudinally extending radial reinforcing strips, of which four, bearing reference numerals **41**, **42**, **43** and **44** are shown in the figure, which serve to transmit forces to the wall engaging portion **36**, in response to the force applied by the spring **15** at the points **30** and **31** through the backing plate **32**. Additional strips **45**, **46** and **47** substantially parallel to the pad face **29** may be embedded in the rear portion of the pad to stiffen this section and thus distribute the forces exerted by the spring **15** more evenly among the strips **41—44**. As in the case of Fig. 2, the backing plate **32** may be removed and the spring pressure applied directly to the center of the rear portion of the pad in the event that the natural radius of curvature of the wall engaging face and the cylindrical reinforcing segment **37** is greater than that of the bore hole.

Figs. 4 and 5 illustrate another embodiment in which a plurality of parallel arms **48** and **49** in a parallelogram type support structure are adapted to urge a pad member **50** against the side wall **10** of a bore hole. The arms **48** and **49** may be biased outwardly by any suitable means such as springs (not shown) disposed within the supporting body **51** on which the arms **48** and **49** are mounted. The outer end of the arm **48** is swingably mounted on a rod **54***a*, the ends of which are secured to the rear of the pad at laterally spaced apart points **54**. A transverse linkage member **52** is connected at one end to the rear central portion of the pad member **50** and at its other end to the arm **48**, a short distance from the rod **54***a*.

In similar fashion, the outer end of the arm **49** is swingably mounted on a rod **55***a* secured at its ends to the rear of the pad at laterally spaced apart points. Also, a transverse linkage member **53** is connected at one end to the rear central portion of the pad **50** and at its other end to the arm **49** a short distance from the rod **55***a*.

As seen more clearly in the transverse sectional view of Fig. 5, the pad member **50** preferably includes a preformed resilient cylindrical segment **56** of reinforcing material such as steel in its wall engaging portion. Also, in order to transmit the forces exerted at the points **54** and the laterally spaced apart points, to which the rod **55***a* is secured, evenly to all points on the face of the pad running parallel to the bore hole axis, a plurality of reinforcing strips **57**, **58** and **59**, also of steel may be provided.

In operation, it will be apparent that when the embodiment of Figs. 4 and 5 is inserted in a bore hole of large diameter, the acute angles between the arms **48** and **49** and the longitudinal axis of the body **51** will be relatively large so that the linkage members **52** and **53** will pull on the rear center section of the pad **50**, the arms **48** and **49** meanwhile applying outwardly directed forces to the pad **50** at the points **54** and the laterally spaced apart points associated with the rod **55***a*. This action adjusts the radius of curvature of the wall engaging portion of the pad **50** to conform closely enough for operating requirements to the radius of curvature of the wall of the bore hole in which the apparatus is then disposed.

In bore holes of lesser diameter, the acute angles between the arms **48** and **49** and the body **51** will be smaller so that the linkage members **52** and **53** will cause the wall engaging surface of the pad **50** to assume a curvature corresponding to a smaller radius in conformity with the smaller radius of the bore hole.

In the embodiment shown in Fig. 6, a pad member **60** is pivotally secured to the outer ends of two parallel arms **61** and **62** forming a parallelogram type supporting system, similar to that shown in Fig. 4. The inner ends of the arms **61** and **62** are pivotally mounted in a body member **65**, suitable means such as springs (not shown) being provided for urging the arms **61** and **62** outwardly to bring the pad member **60** into engagement with the wall of the bore hole.

As shown in Fig. 8, a flexible reinforcing strip **80** of steel or other suitable material is embedded in the pad member **60**. The strip **80** lies parallel to the wall engaging face of the pad **60** and it is preferably preformed to the radius curvature of the smallest bore hole in which the apparatus is to be used. Secured to the strip **80** intermediate the lateral ends thereof is a radial reinforcing strip of steel or other suitable material which extends into a slot **67** formed in the outer face of the arm **61** (Fig. 7). The strip **66** carries a transverse pin **68** which cooperates with a portion of the arm **61** to form a pivotal support for the latter. The outer face **63** of the end of the arm **61** is designed to serve as a cam which is adapted to apply force to the rear face of the pad member **60** to bring the shape of the wall engaging face of the latter into conformity with the shape of the wall of the bore hole. To this end, the cam bearing surface **63** widens at its lower end and is rounded in a horizontal plane, as shown by the dotted line **63'**, so as to have a radius of curvature which continually increases as the surface is followed around to its lower widened end.

The arm **62** is identical with the arm **61** and it is secured to the pad member **60** in the same way. Therefore, it will not be necessary to describe the arm **62** in detail herein.

In operation, it will be seen at once that if the bore hole diameter is large, so that the arms **61** and **62** extend out an appreciable distance from the central body **65**, the lower portions of the cam surface **62** will bear against the back of the pad **60** and conform the pad to the particular enlarged radius of curvature of the cam at this point.

On the other hand, if the bore hole diameter is small, the decreased radius of curvature of the cam surface at its upper end will shape the pad properly to conform to the lessened diameter.

Fig. 9 illustrates a modification of the apparatus shown in Figs. 7 and 8 wherein additional reinforcing strips **91** and **92** made of steel or other suitable material are secured to the section **80**. The strips **91** and **92** serve to distribute the pressures exerted by the cam surface **63** more evenly along the vertical length of the wall engaging portion of the pad between the arms **61** and **62**.

It will thus be seen that the invention provides novel and effective wall engaging carrier means having a pad member including a wall engaging portion which will automatically assume a radius of curvature corresponding to that of the bore hole, for all bore hole diameters within a predetermined range.

It will be understood that the several embodiments described above are susceptible of modification and variation within the spirit and scope of the invention. Thus, for example, a greater or lesser number of reinforcing strips in cooperation with a greater or lesser number of recesses of varied shape and form may be employed, as seems feasible, to attain suitable pad rigidity or resiliency. Those embodiments, therefore, are to be considered merely as illustrative and not as limiting the scope of the appended claims.

I claim:

1. In an apparatus for use in a bore hole having a wall with a radius of curvature lying in a given range, a resilient member adapted to be moved along the wall of the bore hole in engagement therewith, said resilient member having a wall engaging face and a rear portion, means for applying a force to said rear portion to urge said wall engaging face into engagement with the wall of the well, and means facilitating adjustment of the distribution of said force laterally of said member as a function of the radius of curvature of the bore hole, whereby the radius of curvature of said wall engaging face may be brought into conformity with the radius of curvature of the bore hole.

2. Wall engaging equipment carrier means for use in a bore hole, comprising a supporting member adapted to be lowered into the bore hole, a pad member having a bore hole wall engaging face and a rear portion, said pad member having hollow spaces formed therein, means coupling said pad member to said support member and urging the pad member towards the bore hole wall by the application of a force thereto, and means on said pad member rear portion to facilitate the selective distribution of said force from said coupling means through the central portion of said pad member rear portion or laterally spaced portions on opposite sides of said central portion, whereby the wall engaging face of said pad member may be brought into conformity with the bore hole wall in bore holes of a given range of diameters.

3. Apparatus as defined in claim 2 in which the pad member includes a forward laterally extending portion, a relatively narrow, central rearwardly extending portion, and a rear laterally extending portion having forwardly projecting side portions spaced from the rear wall of said forward portion and provided with longitudinally and forwardly extending reinforcing means, thereby producing said hollow spaces in said pad member.

4. Apparatus as defined in claim 2 in which the pad member comprises a body in which said hollow spaces are laterally spaced apart, a reinforcing member having a preformed radius of curvature secured within the body substantially parallel to the wall engaging face of said pad member, a plurality of longitudinally and forwardly extending reinforcing members in said body and a plurality of laterally and longitudinally extending members in said body.

5. Wall engaging equipment carrier means for use in a bore hole, comprising a support member adapted to be lowered into a well, a pad member having a curved, bore hole wall engaging face and a rear portion, means connected to said pad member at laterally spaced locations on said rear portion for coupling said pad member to said support member, and means linking said coupling means to said pad member rear portion at at least one central location thereon.

6. Apparatus as described in claim 5 in which the pad member has a plurality of hollow spaces formed therein, a reinforcing member preformed to a given radius of curvature is secured to the pad member substantially parallel to the wall engaging face thereof, and a plurality of forwardly and longitudinally extending reinforcing means are disposed in the pad member.

7. Wall engaging equipment carrier means for use in a bore hole, comprising a support member adapted to be lowered into a bore hole, a pad member having a curved, bore hole wall engaging face and a rear face, a coupling member pivotally secured at one end to said pad member and coupling the same to said support member, and means forming a cam surface on said one end of the coupling member for cooperating with the rear face of said pad member to alter the shape of the wall engaging face thereof as a function of the angular position of said coupling member relatively to the pad member.

8. Wall engaging equipment carrier means for use in a bore hole, comprising a support member adapted to be lowered into a bore hole, a pad member having a curved, bore hole wall engaging face and a rear face, a plurality of parallel coupling members pivotally secured to said pad member and to said support member to form a parallelogram type mounting for said pad member urging the latter outwardly to engage the wall of the bore hole, and means forming cam surfaces on each of said coupling members for cooperating with the rear face of said pad member to alter the shape of the wall engaging face thereof as a function of the angular positions of said coupling members relatively to the pad member.

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Number	Name	Date
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