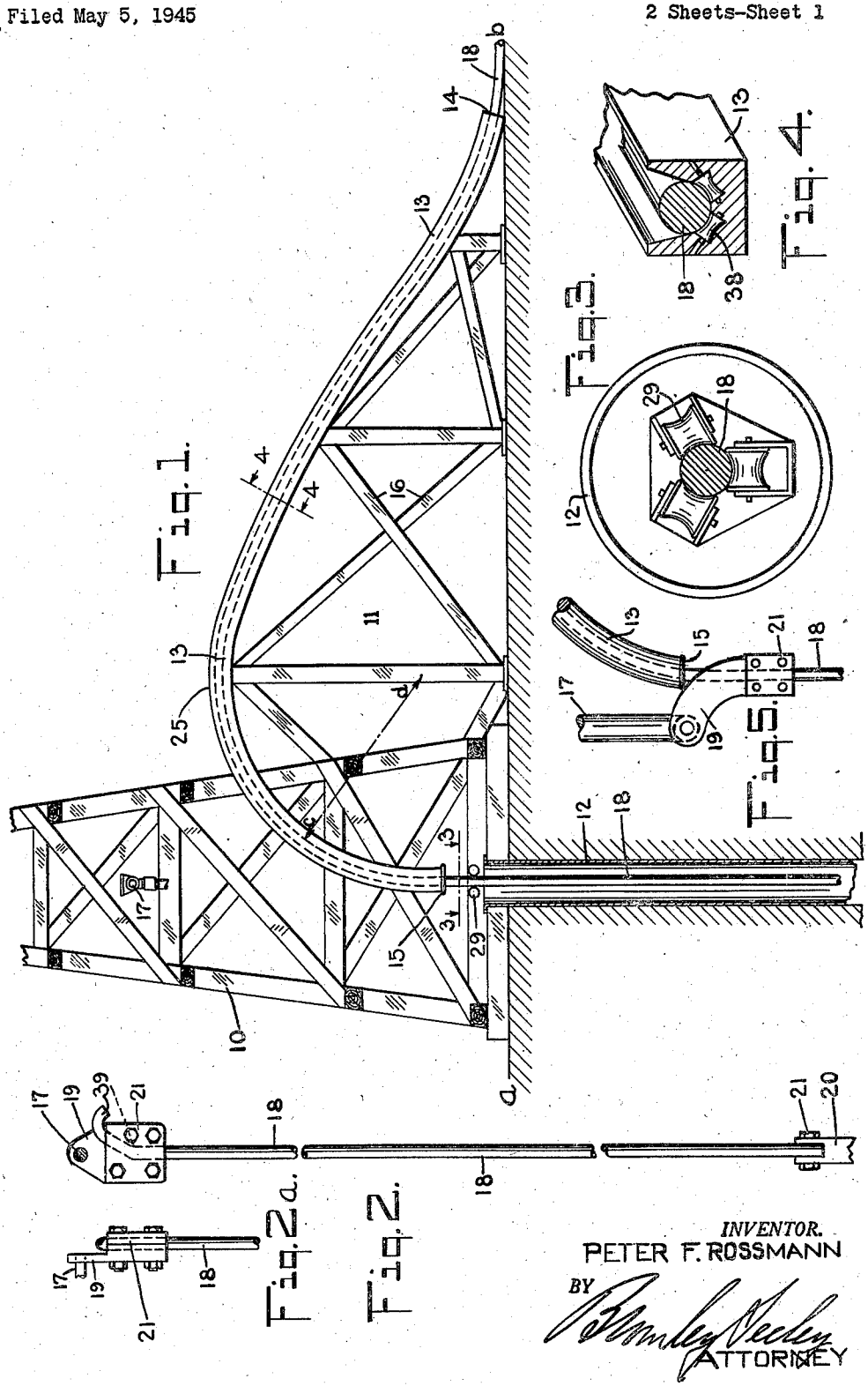
Nov. 2, 1948. P. F. ROSSMANN 2,453,038

ONE-PIECE SUCKER ROD

Filed May 5, 1945 2 Sheets-Sheet 1



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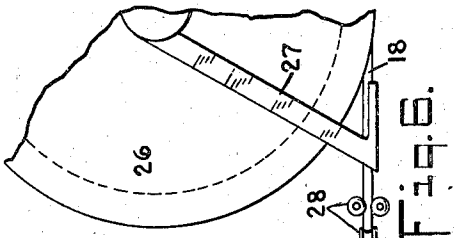


Fig. 6.

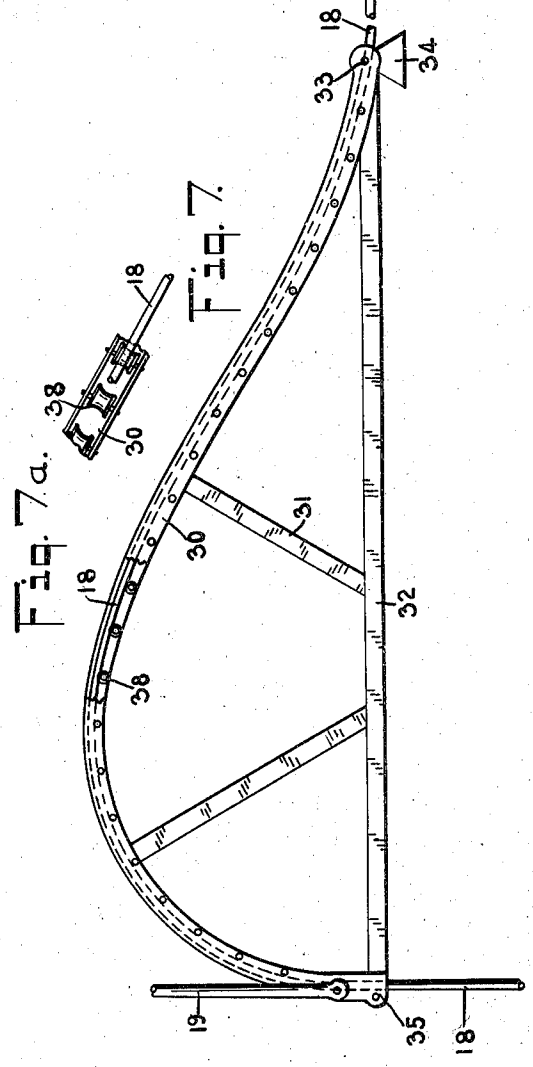


Fig. 7.

Fig. 7a.

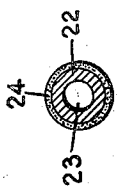


Fig. 8.

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UNITED STATES PATENT OFFICE

2,453,038

ONE-PIECE SUCKER ROD

Peter F. Rossmann, Morristown, N. J.

Application May 5, 1945, Serial No. 592,229

2 Claims. (Cl. 255—11)

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The invention relates to an improved technique in the method of removing sucker rods from and of inserting them into a well; to apparatus for use in practicing the method and to an improved form of article of manufacture, hereinafter referred to as a jointless sucker rod particularly designed for use in practicing the method.

Sucker rods as heretofore constructed are formed of short steel rod sections with an end of one screwed into the end of the next adjacent section. In order to compensate for the weakening effect of the joints, the ends of the sections are enlarged in diameter from that of the sections at their mid-lengths. These joint enlargements necessitate the employment of additional metal which simply adds weight to the structure without materially contributing to the functional capacity of the sucker rod while in use and on the contrary set up local strains which tend eventually to shorten the life of the rods.

These sectional rods are assembled at the place of use by screwing one into the other and as the string of sections are thus formed it is lowered into the well and as the string is being removed from the well the sections are progressively unscrewed from each other. These screwing and unscrewing operations not only involve considerable labor and time in installing and replacing the sectional strings of sucker rods but it not infrequently happens that the screw threads at the ends of the sections become damaged as the result of powerful turning of the sections, and in general unless extreme care is taken in handling the sections, the threads lose their clean cut contour and the outer surfaces of the sections become nicked and bruised with the result that the sections so damaged eventually fail in use under the powerful reciprocating action to which strings of such rods are subjected. Sucker rods as now used develop fatigue stresses which become particularly prevalent in those sections which have not been carefully formed and subsequently protected, with the result that the string as a whole develops areas of weakness which shorten its life.

The present disclosure features a new technique in the handling of sucker rods at the well in that a form of sucker rod of any necessary length is provided which can be lifted out of the well from time to time and laid on the ground or on an appropriate bed for the same to take a period of rest while so lying dormant and in this way tends to avoid fatigue strains irrespective as to where they may be localized.

The primary object of the article aspect of invention is to provide a simple form of sucker rod

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which can be introduced into and withdrawn from the well without necessity of assembling or demounting separate screw sections thereof and in this way affect a saving in operating costs as well as minimizing the possibility of damaging the rod.

Broadly, the invention features a one-piece homogeneous sucker rod capable of functioning as does the present string of sucker rods in reaching from the walking beam or similar mechanism above the ground to the pump, tool or other device operated thereby at the bottom of the well.

Various other objects and advantages of the invention will be in part obvious from an inspection of the accompanying drawings and in part will be more fully set forth in the following particular description of one form of device embodying the invention, and the invention also consists in certain new and novel features of construction and combination of parts hereinafter set forth and claimed.

In the accompanying drawings:

Fig. 1 is a view somewhat diagrammatic of apparatus mostly above ground for changing the direction of movement of a long sucker rod of the type herein featured, and illustrating the sucker rod at least partially intruded into a well and before being attached to the walking beam;

Fig. 2 is a view in side elevation of a sucker rod shown in Fig. 1 with its entire length hanging vertically with the central portion thereof broken out at two places to economize in length and constituting a preferred embodiment of the article aspect of this disclosure with a walking beam connector secured to its upper end;

Fig. 2*a* is a detail in end elevation of the connector shown in Fig. 2.

Fig. 3 is a detailed view of the guide rollers shown above the mouth of the well in Fig. 1 and taken on the line 3—3 of Fig. 1 looking downwardly as shown by the arrows.

Fig. 4 is a detail of the trough-forming part of the cradle of Fig. 1 and taken on the line 4—4 of Fig. 1;

Fig. 5 is a detail showing a walking beam connector engaging the sucker rod herein featured at a point intermediate its ends to permit a further feeding of the rod as a whole into the well and designed for use where there is sufficient flexibility in the cradle to permit the necessary reciprocation of the rod.

Fig. 6 is a view partially in side elevation of a reel on which the rod is conveyed to its place of use with associated straightening rollers.

Fig. 7 is a view in side elevation of a form of cradle modified from its similar form shown in Fig. 1 in that it is hinged to reciprocate with the walking beam and sucker rod.

Fig. 7a is a detail looking down on the cradle of Fig. 7 showing the rollers for supporting the sucker rod.

Fig. 8 is an enlarged cross sectional view of a tubular form of sucker rod.

In the drawings and referring first to the rod handling structure above ground shown in Fig. 1, there is disclosed a skeleton form of super structure including an upstanding derrick **10** of conventional design and a cradle **11** having one end secured to one side of the derrick and extending therefrom for a material distance or as far as may be necessary to function as herein disclosed.

There is also shown the upper or mouth end of a well indicated by its casing **12** and centered conventionally within the outlines of the base of the derrick **10**. The cradle **11** includes primarily a long, open top tubular channel-like trough **13** provided with a horizontally extending intake end **14** and with a depending discharge end **15** above the well casing **12**. The cradle extends somewhat like an amusement park roller coaster above the ground level indicated by the line *a—b* and the trough **13** is supported by a skeleton form of framework **16**. The derrick is provided with a conventional form of walking beam **17** to which sucker rods are usually attached, but in the showing in Fig. 1 the walking beam is free from any sucker rod as this figure is intended to illustrate indifferently the withdrawing or insertion of the sucker rod and for this reason the sucker rod **18** is not shown in its usual vertically suspended operative position. The sucker rod **18** as shown in Fig. 2 is provided at its free upper end with a walking beam connector **19** by means of which it is secured to an end of the walking beam **17**. The lower end of the rod **18** has attached thereto a pump, bucket, tool or other form of deep well tool shown symbolically at **20**. For the purpose of receiving the attachments **19** and **20**, the ends of the rod are fashioned to have these ends of the rod clamped by some suitable or conventional form of clamping means **21**. In order to provide sucker rods of variable active lengths so as to reach down the well for the necessary distance, it is suggested in Fig. 5 that the walking beam connector **19** be designed to engage the rod at any point along its length and as shown in this figure the connector is shown secured in place at the point where the rod begins to arc from its straight depending position on to the direction changing cradle. By loosening the clamping means associated with the connector, it may be momentarily freed from the rod and more and more of the rod may then be fed down the well until the tool **20** is in its desired new position and the connector is then replaced to engage its new location on the rod.

The rod is preferably of cylindrical form and of cold rolled steel with a length sufficient to reach from the surface to the bottom of the well. It is assumed in this disclosure that the rod illustrated is solid, of one inch diameter, has a length of much more than one thousand feet and is capable of withstanding tension of the order of one hundred thousand pounds. It has been found that with a sucker rod of this dimension and material it can be bent about a reel of about one hundred sixteen inches in diameter and keep within the elastic limits of the bar. For the purpose of this disclosure it is understood that there is no part of the cradle trough which has a radius of less than sixty inches. In the showing in Fig. 8 such a rod **22** is shown provided along its core with a bore **23**.

Care is exercised in the preparation of and subsequent handling of rods of this character to insure that the surface is free of nicks, hammer blows, or kinks which might tend to cause the rod to rupture after it had been in use for awhile.

In order to provide protection to the outer surface of the rod when either of a solid or tubular form, it is suggested that it be shielded with a protective coating **24**. A thin coating of electrolytically deposited metal **24** like nickel is indicated in Fig. 8 as being a suitable protective coating.

It is understood, of course, that the weight of such a long rod causes it to elongate when in use and thus imposes internal strains thereon but it is the intent here in to provide a rod which while providing for this unavoidable elongation at the same time will develop the least possible distorting strains. As the present disclosure eliminates the usual knuckles formed by the enlargements at the ends of the sucker rod sections now in use, it is possible to use rods of greater diameter than usual thus tending to reduce internal strain with the use of no more metal than is used at present for the same length of sucker rod string.

It is a feature of this disclosure to lay the rod flat on the ground before it is inserted into the well in order to eliminate kinks, bends and otherwise condition it for its intended use. It is also suggested that from time to time the rod be withdrawn and laid horizontal and thus to give the rod periods of rest. It is appreciated that this movement necessitates the bending of the rod as it moves to and from its horizontal and vertical positions and this is attained by training the wire about a large arc of turn. Care must be used in designing this arc to make sure that the curvature of the rod as it is being bent from one position into the other is within the elastic limit of the material of which the rod is formed.

These factors are taken into consideration in designing the curve of the trough **13** as viewed in side elevation in Fig. 1. Between the intake end **14** and a point **25** of maximum elevation the curve is of gradual and progressively decreasing radius, and from the point of highest elevation **25** to the discharge end **15** the curve forms substantially a 90° arc with a relatively small radius indicated by the radial line *c—d*. It is particularly in the area of this arc of small radius that the curvature of the rod should be within and preferably well within its elastic limit.

While it is within the scope of the disclosure to insert the rod into the well using conventional cable feeding practices in this respect, it is preferable to make sure that the rod is absolutely straight at the time of its first installation. Rods of this type are usually supplied by the manufacturer on large diametered reels such as is shown at **26** and these reels are mounted for rotation on some form of support **27** and are otherwise designed to permit a smooth withdrawal of the somewhat rigid rod. At the time of the first installation the rod is slowly unwound from the reel, care being exercised to protect its surface from abrasions, knocks or other surface damages during this operation. The rod as it is unreeled is first laid flat on the ground and preferably is passed between a set of rod straightening rollers **28** of any conventional design. Preferably long lengths of the rod are permitted to be flat for a

time and the rod is then passed into the intake end 14 of the trough 13; is trained upwardly and then downwardly about the large compound curve defined by the trough and when in depending position is preferably passed through a set of guide rollers 29 located above the mouth of the well and beneath the discharge end 15 of the trough. The rod is permitted to remain with its entire length suspended in the well for a period of time sufficient to permit molecular readjustments of the material of which the rod is formed before being subjected to actual use. The rod so straightened is then carefully lifted from the well, trained upwardly about the short arc and then downwardly about the long curve provided by the cradle and drawn therefrom by traction to lie flat on the ground or on a horizontal support designed to form a horizontal cradle for the rod while being rested.

When ready for use, the advance end of the rod is provided with the required well tool 20 and the rod reintroduced into the well with its rear or trailing end projected above the well. To the upper or trailing end is secured the walking beam connector 19 and which in turn is secured conventionally to the walking beam, or as previously described in connection with Fig. 5 the walking beam may act on a part of the rod which need not necessarily be its end. The sucker rod thus formed operates conventionally with a slow reciprocatory action up and down as does the known forms of strings of sectional sucker rods.

After a period of use, or when necessary to replace the tool 20, the rod is withdrawn from the well as previously outlined and again laid flat on the ground for a period of rest after which it is again installed for active use.

By means of a rod of this character it is possible, after it has been once corrected for kinks or other irregularities, to insert and remove it quickly from the well without necessity of screwing or unscrewing the separate sections as is required with present forms of sectional sucker rods. As the one-piece sucker rod herein featured can be easily protected along its entire length while being inserted or withdrawn from its operative position in the well, there is avoided the present current possibilities of injuring the surface of the rod by careless handling in screwing the sections together and in stacking them while not in use. In those cases where the rod is electroplated, care is exercised to maintain the bright polish formed on the rods in the case of such metals as nickel and in this way the possibility of starting cracks or breaks in the surface of the rod is avoided or at least minimized.

The form of rod herein disclosed features economy in the use of material. With the present known forms of detachable sucker rod it is necessary to enlarge the end portions of each section in order to compensate for the weakening effect of using threaded joints. The rod herein featured has no such joints thus has no need for compensating enlarged knuckles and in general the cross section of material need be of no greater dimension than the minimum cross sectional area of material in the mid-length portions of present forms of sucker rods; or differently expressed, the new rod may be made of less material and thus lighter per unit length than the strings of sucker rods now in general use.

Referring to the pivotally mounted form of trough shown in Fig. 7, it will be understood that it may be substituted in whole or in part for the discharge end of the Fig. 1 form of the invention. Instead of clamping the walking beam to an intermediate portion of the rod as suggested in Fig. 5 the rod in the Fig. 7 form may be progressively fed down the well while the portion both in the well and on the trough is being elevated and lowered. For this purpose in the Fig. 7 showing the rockable trough has its free end connected to the walking beam by connector 19 and is raised and lowered swinging about its remote pivot 33. In this way the portion of the rod extending into the well and also the portion of the rod extending into the trough is reciprocated up and down by the walking beam either while being held fixed to the trough or while being fed through the same.

I claim:

1. Apparatus for guiding a long continuous sucker rod from a horizontal position on the ground into its operative position depending vertically in a well, comprising a cradle having a horizontally disposed intake end for receiving the rod and a vertically disposed discharge end for guiding the rod into the well, and cradle portion between said intake and discharge ends defining a continuous curve gradually curving upward from its intake end to a point of maximum elevation and curving from said point of maximum elevation downwardly to its discharge end, said downward curve being more sharply defined than its upward curve end within the elastic limit of said rod, said downwardly curved end of the cradle being pivotally mounted to rock about a horizontal axis to reciprocate said end and that part of the rod carried thereby to cause said sucker rod to function, and means for rocking said cradle.

2. Apparatus for guiding a long sucker rod from a horizontal position into its operative position depending vertically in an associated well, comprising a cradle having a horizontally disposed intake end for receiving the rod and having a vertically disposed discharge end for guiding the rod into the well, that portion of the cradle between its intake and discharge ends defining a continuous curve gradually curving upward from its intake end to a point of maximum elevation and curving from said point of maximum elevation downwardly to its discharge end, said downward curve being more sharply defined than said upward curve end within the elastic limit of said rod, means for pivotally mounting said cradle to permit reciprocation of its vertical discharge end to thereby reciprocate the portion of said rod depending into said well, and means for reciprocating the discharge end of said cradle.

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Certificate of Correction

Patent No. 2,453,038. November 2, 1948.

PETER F. ROSSMANN

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 6, line 23, claim 1, for the words "and cradle" read *the cradle*;

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 15th day of March, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.