May 23, 1967 C. K. BANKS 3,320,820

BRIDLE GUARD FOR USE IN OIL WELL PUMPING EQUIPMENT

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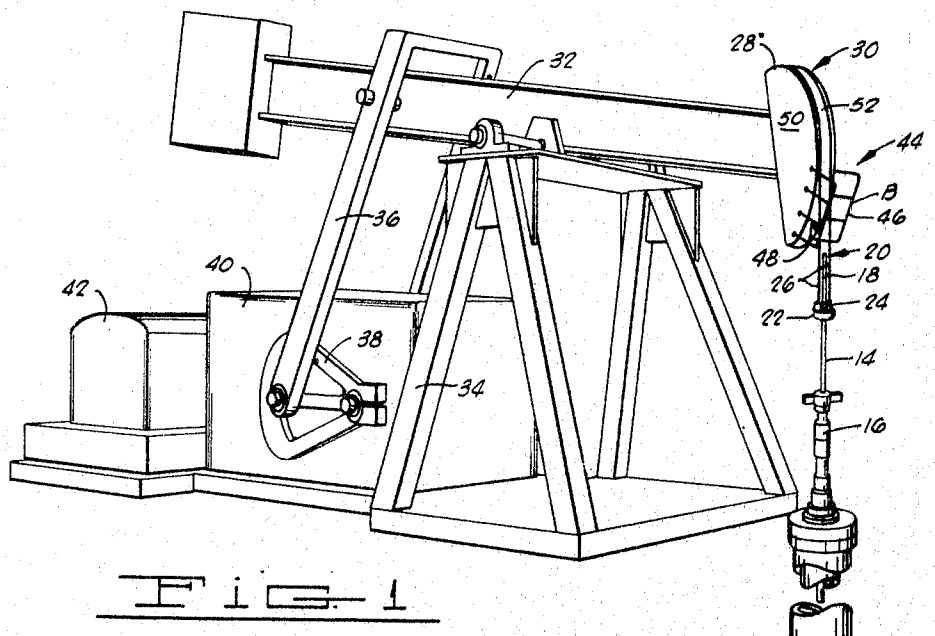


Fig. 1

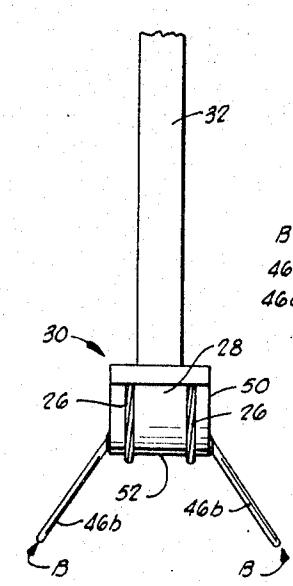


Fig. 2

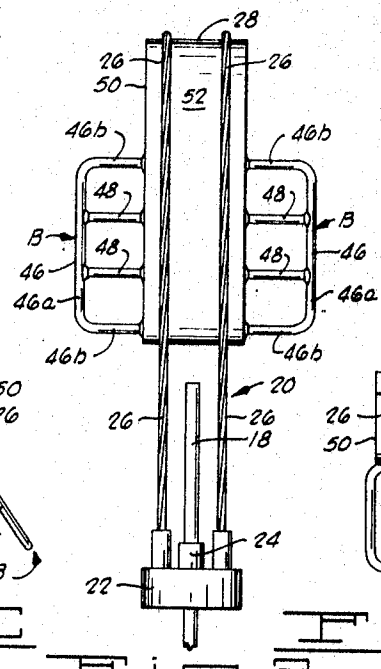


Fig. 3

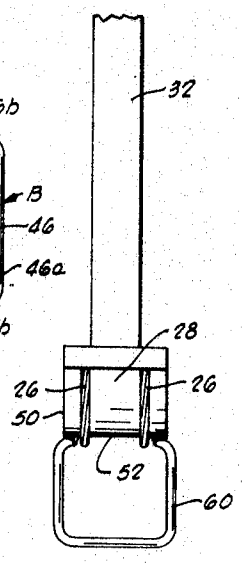


Fig. 4

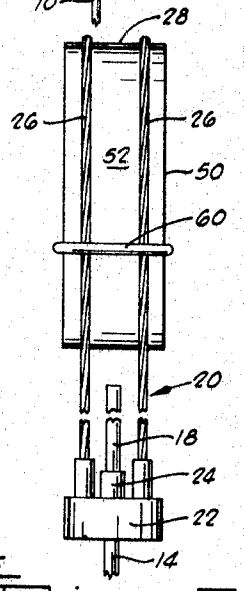


Fig. 5

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BRIDLE GUARD FOR USE IN OIL WELL PUMPING EQUIPMENT

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This invention relates to a bridle guard incorporated in conventional sucker rod pump assemblies used to remove oil from the earth. More particularly, but not by way of limitation, the present invention relates to a brid'e guard structure which is secured to the horse head of a sucker rod surface pumping unit so as to prevent the bridle used in the pumping unit from slipping off the quadrant of the horse head in the event of parting or fracturing of the sucker rod string, thereby causing damage to the polished rod, and to the stuffing box through which it passes.

In sucker rod pumping units of the type conventionally used for removing liquid hydrocarbons from the earth, the pumping unit generally includes a string of sucker rods having as the uppermost rod in the string, a polished rod which passes through a stuffing box located at the upper end of the tubing string and is attached through a flexible cable assembly to the horse head on a walking beam. The walking beam is driven in oscillation by a suitable prime mover and gear reducer unit in accordance with practices well understood in the art. The flexible cable assembly used to connect the polished rod to the horse head includes a pair of generally parallel flexible cables which are attached at one of their ends to a carrier bar clamped to the upper end portion of the polished rod. The other ends of the cables are attached to the upper end of the horse head which is secured to one end of the walking beam, and which has an arcuate quadrant surface over which the bridle cables are passed to their point of attachment at the top of the horse head.

In the operation of sucker rod pumps of the type described, an occasional occurrence is the fracturing or parting of the rod string at some point within the tubing of the well and below the stuffing box. As a result of such parting of the rods, slack is thrown upwardly into the flexible bridle cables during the upstroke of the walking beam. This permits one or both of the two cables constituting the bridle to slip off of the arcuate quadrant surface of the horse head, and to pass along the side of the horse head to a position in which they extend at an angle with respect to the vertical axis of the polished rod. The cables which become misaligned in this way may even be caught behind the horse head in extreme instances.

As the string of rods then falls downwardly during the downstroke, the polished rod is pulled downwardly in the stuffing box, but cannot move freely in a straight vertical line through the stuffing box as is intended in normal, trouble-free operation. Rather, a bending moment is applied by the bridle cables to the polished rod as a result of the misalignment of one or both of the cables, so that the polished rod is jerked and is bent toward the pump unit. The momentum and weight of the falling string continues to exert a large downward force on the bent polished rod with the result that both the polished rod and the stuffing box through which it normally moves in a straight line are frequently damaged beyond repair, and must be completely replaced in order to restore the pumping unit to service. Since the polished rod is the most expensive rod in the sucker rod string, and since stuffing box constructions are frequently quite elaborate, the cost of replacement of the

damaged polished rods and stuffing boxes is generally quite high.

The present invention provides a simple bridle guard device which functions to prevent the pair of cables constituting the bridle used in the sucker rod pump assembly from jumping off of, or sliding from, the arcuate quadrant surface of the horse head and thereby becoming misaligned with the top of the polished rod. Broadly described, the bridle guard of the present invention comprises rigid guide means mounted on the horse head and including a first portion secured to the horse head at a point horizontally spaced from the vertical plane occupied by the central, longitudinal axis of the arcuate quadrant surface of the horse head, and a second portion secured to the horse head at a point thereon horizontally spaced from the vertical plane occupied by the longitudinal axis of the arcuate quadrant surface of the horse head, and disposed on the opposite side of said vertical plane from the point of securement of said first portion. The guide means of the bridle guard further includes cable guiding portions extending outwardly from the arcuate quadrant surface of the horse head from said first and second portions for confining and guiding the two cables included in the conventional bridle structure. In the described arrangement, the two cables of the bridle pass between the outwardly extending cable guiding portions of the bridle guard, and are prevented by these guiding portions from moving laterally with respect to the plane of movement of the walking beam so as to slip off of the arcuate quadrant surface of the horse head and into misalignment with the vertical axis of the described, may assume various forms including loop, polished rod.

The bridle guard of the invention, as thus broadly described, may assume various forms including loop, ring or semi-ring structures which are secured at two points identified as the first and second portions in the broad description set forth above, with the two points of securement being on opposite sides of the vertical plane containing the central, longitudinal axis of the arcuate quadrant of the horse head. Alternatively, the bridle guard may take the form of a pair of horizontally spaced guide brackets which cooperate in forming an open channel through which the central longitudinal axis of the arcuate quadrant of the horse head passes, and which confines the two cables of the bridle structure to prevent cable misalignment of the type hereinbefore described in the event of the occurrence of parting of the sucker rod string.

A specific, preferred embodiment of the invention comprises a pair of horizontally spaced, generally U-shaped members or brackets each having an elongated bight portion and a pair of relatively short legs at each end of the bight portions, with the legs secured at their ends to the side faces of the horse head. The legs extend outwardly from the horse head past the arcuate quadrant surface thereof so that the two U-shaped brackets cooperate in forming a channel limiting movement of the dual cables of the bridle to their intended area of movement on the arcuate quadrant surface. The specific embodiment of the invention preferably further includes, in addition to the horizontally spaced, U-shaped brackets, a plurality of braces each extending from a point of securement at one end thereof to the side surfaces of the horse head, to a point of securement at the other end to the bight portion of the brackets so as to reinforce and impart additional mechanical strength to the brackets. This embodiment of the invention, in addition to its described function as a bridle guard, provides ladders mounted on the horse head and useful in climbing to the top of the horse head to detach or disconnect it from the walking beam in maintenance operations.

From the foregoing description, it will have become apparent that it is a major object of the present invention to provide a bridle guard for use on the horse head portion of a sucker rod pumping unit so as to prevent damage to the sucker rod and stuffing box in the event of the occurrence of parting or fracturing of the sucker rod string at a point below the polished rod.

An additional object of the invention is to provide an inexpensive, yet mechanically rugged bridle guard which functions to prevent movement of the cables included in the bridle of a sucker rod pumping unit from their intended operating position in contact with the arcuate quadrant surface of the horse head in the event of the development of slack in such cables.

A further object of the invention is to provide a simple, easily installed bridle guard for use in a sucker rod pumping unit to assure proper location of the bridle cables during all phases of operation of the unit, which bridle guard is characterized in having a long and trouble-free operating life.

In addition to the foregoing described objects and advantages, additional objects will become apparent as the following detailed description of the invention is read in conjunction with the accompanying drawings which illustrate the invention.

In the drawings:

FIGURE 1 is a perspective view of a conventional sucker rod unit with the present invention installed thereon.

FIGURE 2 is a plan view of the outer end portion of the walking beam illustrating the manner in which one embodiment of the bridle guard of the present invention is secured to the horse head of the pumping unit.

FIGURE 3 is an elevation view of the horse head of the pumping unit as it appears when viewed from a point ahead of, and horizontally spaced from, the end of the walking beam which carries the horse head.

FIGURE 4 is a plan view of the end of the walking beam and the horse head carried thereby, and illustrating a different embodiment of the bridle guard of this invention attached to the horse head.

FIGURE 5 is a view in elevation similar to FIGURE 3 and further illustrating the modified embodiment of the invention depicted in FIGURE 4.

Referring now to the drawings in detail, and particularly, to FIGURE 1, the conventional sucker rod pump unit there illustrated includes a sucker rod string **10** enclosed in the usual well tubing **12**, and including at its upper end, a polished rod **14** which extends through a stuffing box **16**. The upper end portion **18** of the polished rod **14** is connected to a bridle designated generally by reference character **20** through a carrier bar **22** and a polished rod clamp **24**. The bridle **20** includes a pair of flexible cables **26** which are connected at their lower ends to the carrier bar **22** and at their upper ends to the upper portion or top **28** of a conventional horse head **30** of the type used in sucker rod pumping units. The horse head **30** is connected to one end of a walking beam **22** which is pivotally mounted on top of a samson post **34**. The walking beam **32** is driven in its oscillating pumping motion by a pitman **36** which in turn is driven by a crank arm **38** connected through a gear reducer **40** to a prime mover **42**.

In accordance with the present invention, a bridle guard designated generally by reference character **44** is provided on the horse head **30** and includes, in a preferred embodiment of the invention, a pair of bridle guide brackets B which each comprise a generally U-shaped member **46** and a plurality of transverse braces **48**. The U-shaped members **46** include elongated bight portions **46***a* and a pair of generally parallel leg portions **46***b* which are welded or otherwise suitably secured at their free ends to a side face **50** of the horse head **30**. The bridle guide brackets B are secured to the opposite side faces **50** of the horse head **30** and are therefore spaced horizontally

from each other so as to define a channel of the type best illustrated in FIGURES 2 and 3.

Described in another way, each of the leg portions **46***b* of each of the U-shaped members **46** in each bridle guide bracket B is secured to the respective side face **50** at a joint relatively close to the intersection of the side face with the arcuate quadrant surface **52** of the horse head, and from their points of securement to the respective side faces, the legs **46***b* extend forwardly and outwardly at an angle with respect to the side faces so as to form the generally V-shaped channel best illustrated in FIGURE 2. The U-shaped members **46** in each of the bridle guide brackets B is preferably positioned relatively near to the lower end of the horse head **30** so that the cables **26** of the bridle **20** will move into and be confined by the thus defined channel during the latter portion of the upstroke of the walking beam. It is at this period in the operation of the walking beam **32** when slack is most likely to be developed in the cables in the event the sucker rod string becomes parted.

The transverse braces **48** which are provided are secured at one of their ends to the respective side faces **50** of the horse head **30** and at their other ends to the bight portion **46***a* of the U-shaped members **46** included in each of the bridle guide brackets B. The transverse braces **48** function to lend mechanical strength to the bridle guard. It should further be pointed out that, by making the elongated bight portions **46***a* of the U-shaped members **46** substantially longer than is illustrated in FIGURES 1 and 3 so that the bridle guide brackets B extend further up the vertical dimension of the horse head **30**, the bridle guide brackets can also be used as ladders to permit maintenance personnel to more easily have access to the elements used to secure the horse head to the walking beam **32** when it is desirable to remove the horse head therefrom. This has previously been a difficult and dangerous task on large pumping units, and the dual function of the preferred embodiment of the bridle guard **44** of this invention thus greatly enhances its value.

A convenient method of constructing the bridle guide brackets B in the form illustrated in FIGURES 1 through 3 is to form the U-shaped members **46** from a relatively long length of junk sucker rod, and also to construct the transverse braces **48** from junk sucker rod.

Operation

In order to better understand the operation of the bridle guard **44** of the invention, it is believed that it will be helpful to initially briefly describe the problem which is solved by the invention by referring to FIGURE 1 of the drawings. If the sucker rod string **10** parts on the upstroke of the pump, as is most frequently the time of the occurrence of such parting, the momentum of the upward movement of the string as the horse head **30** continues to move upwardly will result in the development of slack in the cables **26** at the termination of the upstroke. The occurrence of such slack then permits the cables to move loosely on the arcuate quadrant surface **52** of the horse head **30** and an opportunity exists for the cables to slip off of this surface and pass backwardly along the sides **50** of the horse head toward the samson post **34**. At the same time, upon cessation of the upward stroke, the rod string pulls the polished rod **14** downwardly through the stuffing box **16** and applies tension to the cables **26**. In passing from the arcuate quadrant surface **52** along the sides **50** of the horse head **30**, however, the cables **26** become misaligned with the vertically extending axis of the polished rod **14** and exert a bending moment on the polished rod as it is pulled downwardly through the stuffing box **16**. The polished rod **14** thus will become bent and cannot pass smoothly through the stuffing box **16**, with the result that both the stuffing box and the polished rod are permanently damaged.

As a result of the incorporation of the bridle guard **44** of the present invention in the sucker rod pumping unit, the cables **26** are retained in a channel defined by the bridle guide brackets B and cannot move off of the arcuate quadrant surface **52** of the horse head. There is thus no possibility of the cables **26** becoming misaligned with the vertical axis of the polished rod **14**, and no bending of the polished rod **14** can occur despite the development of slack in the cables on the upstroke following parting of the rod string.

A modified embodiment of the invention is illustrated in FIGURES 4 and 5. In this embodiment, the two bridle guide brackets B are replaced by a loop or semi-annular member **60** which is secured to the horse head **30** in the manner illustrated in FIGURES 4 and 5. At least two points of securement of the generally annular member **60** are provided, with such points lying on opposite sides of the vertical plane containing the central, longitudinal axis of the arcuate quadrant surface **52** of the horse head **30**. The portions **62** of the annular member **60** which are secured to the horse head in the described locations may be referred to as connected or secured portions, and in yet another embodiment of the invention not illustrated herein, the loop forming the guard may assume the form of a complete endless ring which is merely secured along one side thereof to the arcaute quadrant surface **52** of the horse head; preferably in a small recess formed in this surface to permit the cables **26** to run freely thereover.

The manner in which the loop-type bridle guard functions to prevent damaging of the polished rod **14** and stuffing box **16** is substantially identical to that described in referring to the embodiment illustrated in FIGURES 1 through 3 in that the loop **60** provides a closed channel for the cables **26** and prevents them from sliding off the arcuate quadrant surface **52** and along the sides **50** of the horse head **30**. In some instances, it may be desirable to provide a plurality of the loops **60** secured to the horse head in vertically spaced relation therealong.

From the foregoing description of the invention, it will have become apparent that the present invention provides a very useful, mechanically dependable, yet inexpensively constructed bridle guide which serves to confine the cables of a sucker rod pumping unit bridle to the path of movement in which they are intended to move during normal, trouble-free operation. The bridle guard can assume several different or alternative forms and may be made of a number of materials of construction. A limited number of such embodiments have been illustrated herein, and have been described in considerable detail in order to provide an example of the manner in which the principles of the invention can be effectively practiced. All modifications and innovations which are made in the described structure without departure from

the principles outlined herein are therefore intended to be circumscribed by the spirit and scope of the invention except as the same may be necessarily limited by the appended claims or reasonable equivalents thereof.

I claim:

1. The combination of:

a horse head having an arcuate quadrant surface, said quadrant surface having a central, longitudinal axis lying in a vertical plane;

a bridle extending over said surface; and

a pair of horizontally spaced bridle guide brackets mounted on said horse head on opposite sides of said arcuate surfaces, each of which comprises:

a generally U-shaped member having a bight portion and a pair of legs extending from said bight portion and secured to the horse head at a point horizontally spaced from the vertical plane occupied by the central, longitudinal axis of the arcuate quadrant surface of the horse head and extending at an angle with said surfaces in a direction away from said horse head, the legs of each of said generally U-shaped members being secured to said horse head on the opposite side of said vertical plane from the legs of the other generally U-shaped member, said legs and bight portions of each of said U-shaped members forming a cable guiding portion whereby said guide brackets define therebetween a channel for confining said bridle and limiting the movement thereof to said arcuate quadrant surface.

2. A bridle guard as defined in claim **1** and further characterized to include a plurality of transverse braces extending from the bight portion of each of said U-shaped members in a direction substantially parallel to said legs and of substantially the same length as said legs to facilitate securement of said transverse braces to said horse head.

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