

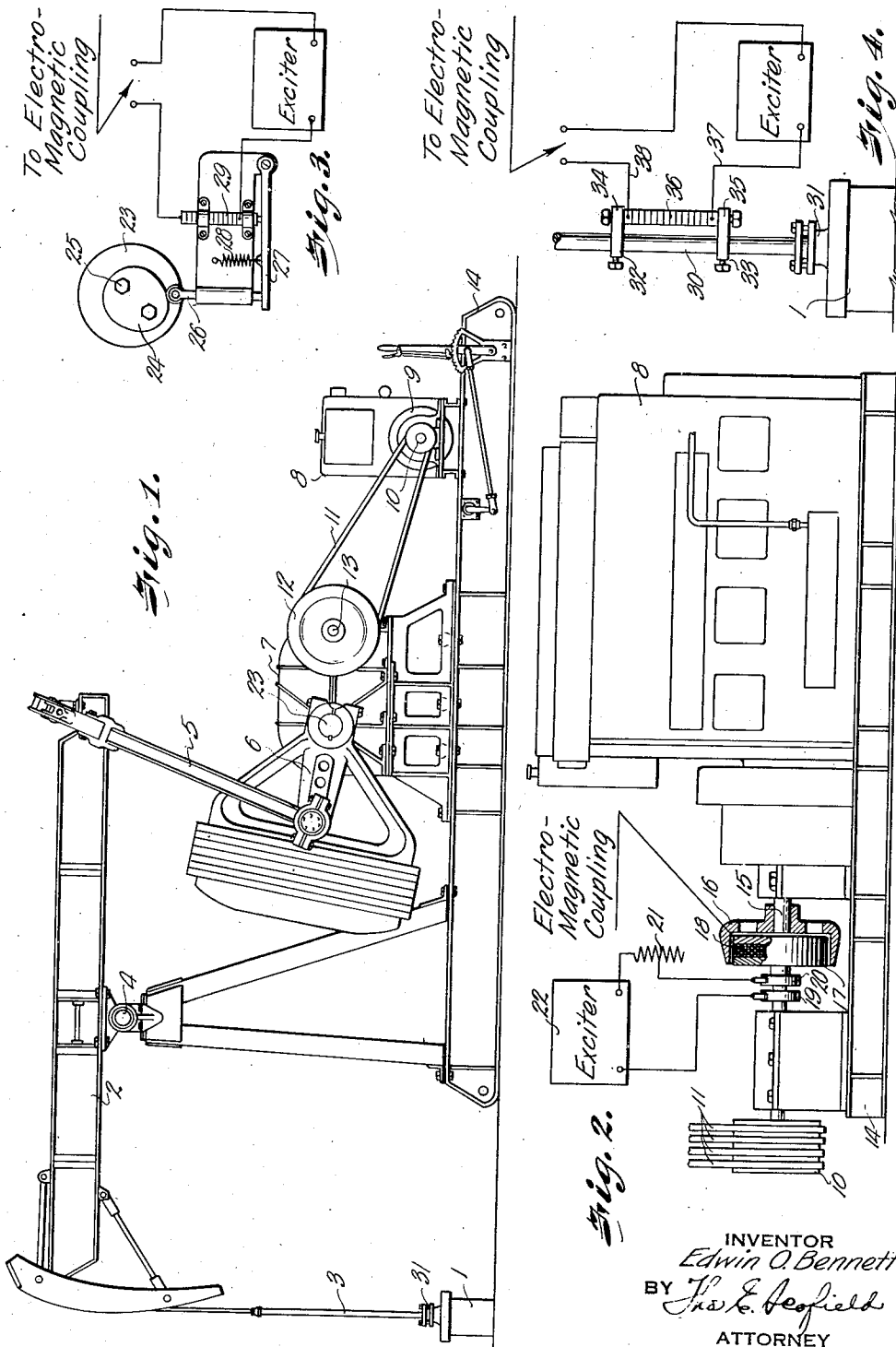
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E. O. BENNETT

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WELL PUMPING ASSEMBLY

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WELL PUMPING ASSEMBLY

Edwin O. Bennett, Ponca City, Okla., assignor to
Continental Oil Company, Ponca City, Okla., a
corporation of Delaware

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4 Claims. (Cl. 74-41)

My invention relates to a well pumping assembly, and more particularly to an assembly for eliminating peak stresses in the rods of pumps for deep wells, such as oil wells.

Oil is recovered from most non-flowing wells by means of reciprocating pumps operated by a line or string of rods called "sucker rods." The loading on the rods varies during different parts of the stroke. At the beginning of the upstroke, the stress in the rods frequently exceeds the normal pull required to raise both the rods and the load of oil by several thousand pounds. The peak stress thus set up does no useful work in lifting oil from the well. The subjecting of the rods to this stress shortens the life of the rods and increases the cost of pumping oil. Other stresses are occasioned by the harmonic motion of the prime mover and by the resultant variations in acceleration during the pumping movements.

The prime movers commonly employed for oil well pumping are constant speed machines such as internal combustion engines. In some pumping systems, induction motors are employed to operate the pumping mechanism. It has been found, in pumping systems so operated, that rod breaking is an occurrence less frequently encountered. This is due to the "slip" between the rotor of the induction motor and the revolving field which occurs when acceleration changes place increased stress upon the rods.

One object of my invention is to provide a well pumping assembly in which stresses due to acceleration changes and peak loads are automatically relieved electrically, enabling me to use a constant speed prime mover, of any suitable character.

Another object of my invention is to provide an oil well pumping assembly in which the pull or stresses on the rods may be limited to any desired predetermined value.

Other and further objects of my invention will appear from the following description.

In the accompanying drawing which forms part of the instant specification and is to be read in conjunction therewith, and in which like reference numerals are used to indicate like parts in the various views:

Fig. 1 is a side elevation of a pumping assembly showing one embodiment of my invention.

Fig. 2 is a diagrammatic end view with parts in section of a portion of the assembly shown in Fig. 1, on an enlarged scale.

Fig. 3 is a diagrammatic view showing a detail of a control arrangement.

Fig. 4 is a diagrammatic view showing another control arrangement.

Referring now to the drawing, the well casing is indicated diagrammatically by the reference numeral 1. A walking beam 2 operates a string of sucker rods 3. The walking beam is oscillated around bearing 4 by a pitman 5, which is connected to a crank 6, driven through a reduction gear housed in casing 7. An internal combustion engine, such as a Diesel engine, 8 is adapted to furnish power through an electromagnetic coupling, indicated generally by the reference numeral 9, to driving pulley 10. The pulley 10 is connected by multiple belts 11 to pulley 12 mounted on a shaft 13, which drives the reduction gear train housed in housing 7. The assembly is mounted upon a bed frame 14.

Referring now to Fig. 2, the prime mover 8 is provided with a shaft 15 which drives the outer section 16 of an electro-magnetic coupling. The outer section 16 is the squirrel cage portion. The inner portion 17 of the electromagnetic coupling contains coils 18. Torque set up between the section 17 and the section 16 of the coupling is a function of the current flowing through the windings of the coils 18. Exciting current is fed to the windings of the coils 18 through slip rings 19 and 20. A rheostat 21 provides manual regulation of the exciting current. The current is supplied from any suitable source, such as a storage battery, transformer, generator, or the like, indicated diagrammatically as "exciter" and the reference numeral 22.

The amount of excitation current is adjusted to limit the torque delivered to the gear unit. This limitation will control the peak stresses which can be induced in the well pumping rods, and will therefore prevent their breakage due to excess loading.

Referring now to Fig. 3, I have shown one means of automatically varying the excitation during a single cycle of the slow speed shaft of the gear unit, which is the cycle for the well pump rod. By referring to Fig. 1, it will be seen that slow speed shaft is indicated by the reference numeral 23, being the shaft to which the crank 6 is keyed. To the shaft 23 I secure a cam 24 by stud bolts 25, or in any other suitable manner. The cam is adapted to reciprocate a follower 26, the lower end of which engages a pivoted arm 27. The arm is urged upwardly by means of a spring 28, compressing a carbon pile 29. It is understood that any other suitable variable resistance may be employed.

The carbon pile 29 is in the circuit of the ex-

citing coils 18 of the electromagnetic coupling. As the shaft 23 rotates the cam 24 will turn with it and vary the compression which the spring 25 may exercise upon the carbon pile 26.

The excitation current may be varied through any suitable range by the cam, or may be entirely interrupted during any part of the cycle by a suitably designed cam. The current may be interrupted several times during a cycle if desired. The angular position of the cam on the shaft 23 may be easily adjusted and the arrangement is such that high torques and stresses normally occurring in pump rods may be entirely eliminated.

A preferred and automatic means of controlling the torque input directly as a function of the load is shown in Fig. 4, in which the reference numeral 30 indicates the polish rod, that is, the portion of the rod string which passes through the stuffing box 31. Clamps 32 and 33 are rigidly fastened to the polish rod 30 when the rod is stationary. The only stress in the rod between points 32 and 33 will be that due to the static load of the rods. The clamps are provided with lateral extensions 34 and 35 between which is positioned a carbon pile 36. The conductors 37 and 38 are secured to the carbon pile so that the exciting current must pass through the carbon pile resistance.

When the pumping operation is started, an increase in the load on the rods will cause an elongation, increasing the resistance through the carbon pile and decreasing the exciting current. Any change in the length of the rod will vary the compression on the carbon pile resistor and alter the excitation current inversely as a function of the load. When the load is great, the exciting current will be less. When the load is small the exciting current will be great. Hence the maximum load taken by the rods is automatically adjusted thus limiting stresses and giving longer life to the rod string with fewer failures.

It will be seen that I have accomplished the objects of my invention. I have provided a deep well system in which peak stresses are automatically eliminated. I have further provided an electromagnetic torque control coupling in which the coupling is varied either in synchronism with the pump rods or automatically as a function of the load.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of my claims. It is further obvious that various changes may be made in details within the scope of my claims without departing from the spirit of my invention. It is, therefore, to be understood that my invention is not to be limited to the specific details shown and described.

Having thus described my invention, I claim:

1. A pumping assembly for wells having a line of pumping rods adapted to actuate a pump within the well, including in combination a prime mover, a walking beam, means between the prime mover and walking beam for oscillating the same, said means including an electromagnetic coupling having an exciting coil, a source of potential for energizing said exciting coil, a resistance in series with said exciting coil, and means for varying said resistance directly as the stresses set up in the pumping rods by the pumping operation.

2. A pumping assembly for wells having a line of pumping rods adapted to actuate a pump within the well, including in combination a prime mover, a walking beam, means between the prime mover and walking beam for oscillating the same, said means including an electromagnetic coupling having an exciting coil, a source of potential for energizing said exciting coil, a resistance in series with said exciting coil, a cam, means for moving said cam in timed relation with said pumping rods, said cam being shaped to increase said resistance at times of increased stress in the pumping rods during the pumping operation, and to decrease said resistance at times of reduced stress in the pumping rods.

3. A pumping assembly for wells having a line of pumping rods adapted to actuate a pump within the well, including in combination a prime mover, a walking beam, means between the prime mover and walking beam for oscillating the same, said means including an electromagnetic coupling having an exciting coil, a source of potential for energizing said exciting coil, a resistance in series with said exciting coil, means rigidly affixed to said rods at two spaced points therealong, and means carried by said last named means for varying said resistance directly as the distance between said means affixed to the rods.

4. In an oil well pumping assembly, a prime mover, a walking beam, a string of sucker rods reciprocated by said walking beam, means between said prime mover and said walking beam for oscillating the same, said means including an electromagnetic coupling having an exciting coil, a circuit for said exciting coil including a source of potential and a variable resistance, a pair of clamps secured to said sucker rods at separated places therealong, said clamps supporting said variable resistance and having means for varying said resistance directly as elongation of said rods due to stresses imposed thereon, the construction being such that peak stresses are avoided due to the automatic variation of the electromagnetic coupling inversely as the instantaneous load.

EDWIN O. BENNETT.