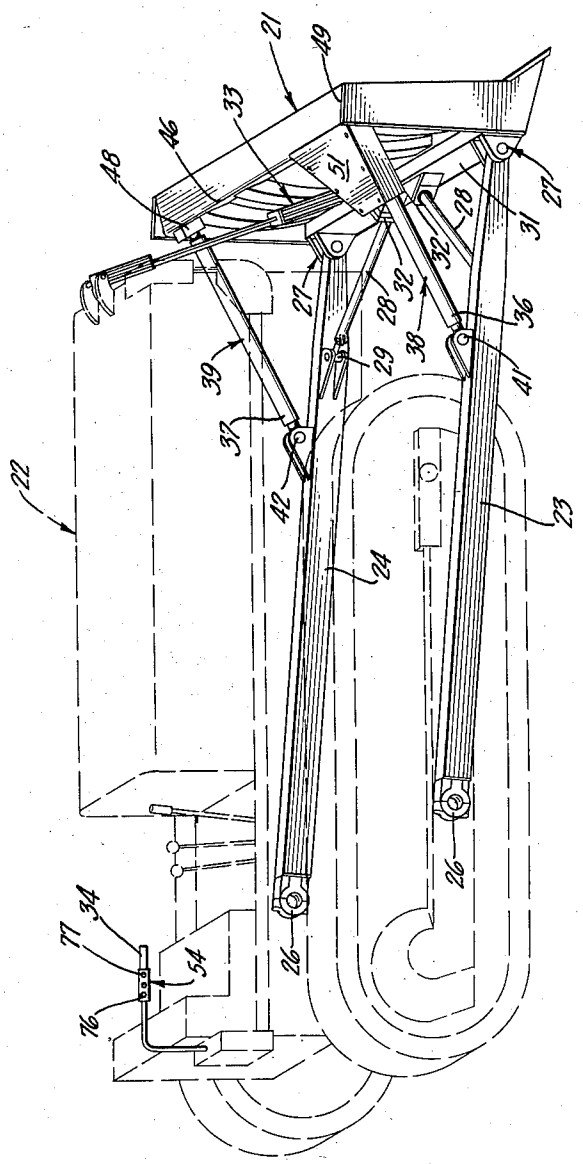
Jan. 20, 1959 A. R. PEREIRA 2,869,256

BULLDOZER BLADE TILTING DEVICE

Filed Nov. 8, 1954 2 Sheets-Sheet 1

FIG. 1



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FIG. 2

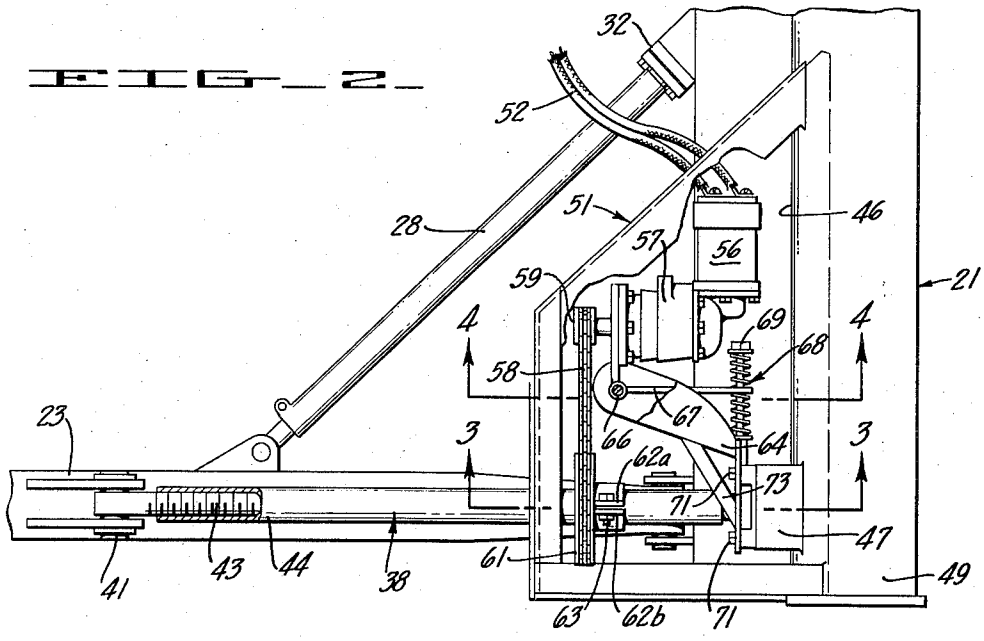


FIG. 3

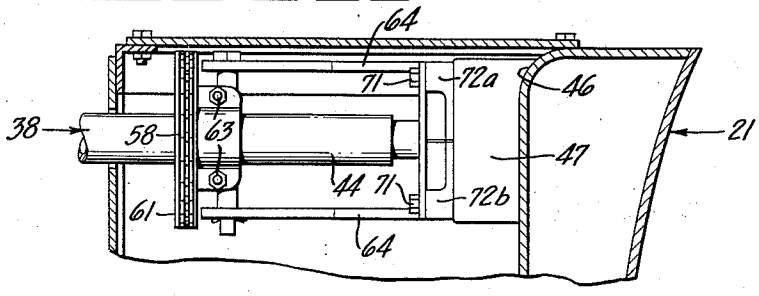
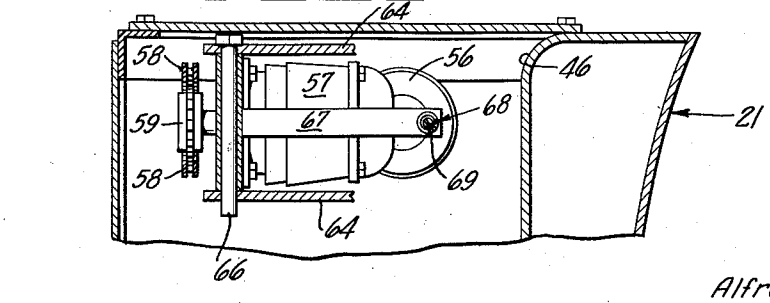


FIG. 4



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BULLDOZER BLADE TILTING DEVICE

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Application November 8, 1954, Serial No. 467,255

4 Claims. (Cl. 37—144)

The present invention relates to improvements in adjustable mountings for grader blades or moldboards on tractor powered earth working machines commonly referred to as bulldozers or push graders. These machines include a transverse grading blade disposed ahead of the tractor and supported therefrom by a transversely spaced pair of independently mounted, forwardly protruding, inextensible side arms, in conjunction with paired adjustable bracing means.

In particular, this invention is directed to an electrically actuated and powered blade tilting means adapted for incorporation and use with one or more of the adjustable blade bracing means generally provided as integral components of modern bulldozers.

As a matter of introduction, it is well to understand the conventional significance of certain terms used in conjunction with bulldozer blades. First, the "angle" of a bulldozer blade is that degree of arc by which the blade deviates horizontally from an imaginary plane normal to the fore and aft axis of the bulldozer. Secondly, the "pitch" of a bulldozer blade is the angle of vertical deviation from the aforementioned plane. Finally, the "tilt" of a bulldozer blade is the angle of rotation of the blade about the aforesaid fore and aft axis.

The desirability of providing some means on bulldozers for varying the tilt of the grading blade in relation to the surface being worked is well recognized, particularly in view of the difficulty encountered in bulldozing terrain having uneven topographical features and varying geologic formations of heterogeneous composition and texture. Furthermore, in many instances in the building of roads and trails, it is necessary to cut and gouge the road or trail grade on the side of a hill and the bulldozer must necessarily assume the same angle as the hill until the grade is sufficiently cut into the hillside to make a roadway large enough for the vehicle to travel thereon. It is evident, therefore, that unless some means are provided to allow the grading blade to assume an angle of tilt different from the angle of repose of the hillside, the cutting and gouging of a grade through a hillside by a bulldozer would be extremely difficult, if not practically impossible.

Hence, it is within the contemplation of the invention to provide improved means for varying the angle of tilt of the grading blade from its normal horizontal position so that pressure on the blade will be varied accordingly, thereby causing a portion of the blade to do a greater amount of work by cutting at a proportionally greater angle to the surface of the terrain.

While the art teaches the application of manually, or even, hydraulically, operated blade tilting mechanisms, in most instances and for various reasons these suggested mechanisms are not entirely satisfactory. For example, manually operated extendable mountings for bulldozer blades are, of necessity, inconvenient for ready adjustment. As continual differences in terrain dictate modification of the blade tilt angle, the operation of the bulldozer must temporarily be suspended while the

operator climbs down from his seat or cab to regulate, according to previous estimate, the angle of tilt of the grading blade. Such process necessarily results in loss of time for both the operator and the bulldozer, thereby increasing overall costs. Moreover, it is often necessary for the operator to make more than one adjustment before the proper tilt angle is discovered for each particular instance of change in terrain.

As a further example, where hydraulic means are suggested for regulating the tilt angle of the blade, a complete system of hydraulic power must be made available. Such system is not an integral part of many types of bulldozers. The incorporation of a complete hydraulic system into an otherwise non-hydraulic bulldozer for purposes of changing the tilt angle of the grading blade would be expensive and result in a cumbersome and bulky modification. Even in those bulldozers which are originally provided with their own extensive hydraulic system, the various hydraulically powered blade tilting mechanisms are not readily adaptable for integration therewith.

Accordingly, it is an object of the present invention to provide electrically powered means for permitting the grading blade of a bulldozer to acquire a tilt angle different from the angle assumed by the vehicle itself.

It is a further object of this invention to provide electrical means for varying the tilt angle of the grading blade from its normal horizontal position in order to permit bulldozer operation in terrain having differences in contour, composition and geologic formation, and thereby compensating for said differences.

Another object of the invention is to provide electrical blade tilting means wherein the power for said means is received from a conventional component of the vehicle to which it is attached, in this instance, from the bulldozer electric storage battery.

A still further object of the invention is to provide electrical means for raising and lowering one side of the grading blade while the bulldozer is continuing with the task at hand and without the necessity of the operator's leaving his working position, thereby materially reducing the amount of time and effort required to adjust the position and angle of the blade and also enabling better adjustment of the blade by direct and immediate modification of the tilt angle.

A very important object of the invention is to provide electrical means for permitting the operator of the bulldozer to alter the position of the blade so that the degree of bite of the blade and the amount of work to be performed by the blade may be varied to meet the needs at hand.

Still another object of the invention and one of substantial importance is to provide an electrically actuated and powered bulldozer blade tilting mechanism capable of being integrated within the modern bulldozer with a minimum of complications. The mechanism of the present invention can be marketed separate and apart from the bulldozer, as a packaged attachment, or, it can be incorporated within the bulldozer at time of manufacture without undue difficulty.

A still further object of the invention is to provide electrical means for modifying the pitch of the bulldozer grading blade as well as the tilt thereof.

Other and further objects of the invention include the provision of an electrical blade tilting device which is adaptable to both angling and non-angling types of bulldozers, supplies its own protection from dirt and boulders which pile up and over or around the ends of the blade, has a minimum number of parts, and is simple and inexpensive to manufacture, assemble and disassemble.

Still other objects and advantages will be apparent

from a consideration of the following description and claims, in conjunction with the drawing wherein:

Figure 1 is a perspective view of the tilting device of the present invention, mounted in operative position on a bulldozer blade assembly.

Figure 2 is a top plan view of the tilting device.

Figure 3 is a cross sectional view of the tilting device taken substantially on the plane of line 3—3 of Figure 2.

Figure 4 is a cross sectional view taken substantially on the plane of line 4—4 of Figure 2.

Generally speaking, there are two principal types of bulldozers in everyday use. One type is termed the "straight blade" type and does not allow for angling of the blade by shortening or lengthening the distance of either end of the blade from the tractor impeller. The other type is called the "angling blade" bulldozer and, accordingly, allows for changing the angle of the blade through appropriate adjustment. Most bulldozers, regardless of type, have integrated therewith a pair of transversely spaced, forwardly extending arms or lateral members which are pivotally mounted on the tractor and serve to support the grading blade or moldboard some distance ahead of said tractor. These lateral members can generally be raised or lowered at their fore ends with a certain degree of independence from each other. Moreover, the lateral members are in many cases semi-rigidly attached to the grading blade by means of pins which permit considerable freedom of movement within each connection between the lateral members and the blade. Although a limited degree of tilting of the b'ade is possible even in those instances wherein the blade may be rigidly attached to the lateral members, the provision of the aforementioned semi-rigid attaching pins allows for easier tilting of the blade through elevation or depression of the individual lateral members at their fore ends.

As means for support and control of the blade, in addition to the lateral members or side arms already described, many bulldozers are equipped with paired push arms or braces which are adjustable as to length by means of a threaded rod and sleeve arrangement forming an extensible compression unit functioning as a substantially collinear telescopic mechanism along a straight line of force between the extremities of the respective push arm. Paired diagonal braces are also provided for increased support of the blade. For example, this type of construction is found in a variety of bulldozers supplied by the Caterpillar Tractor Co., of Peoria, Illinois. In bulldozers so designed, the pitch of the blade may be varied by extending or retracting both push arms by manual y rotating the sleeves around the threaded rods through the use of an adjusting tool or bar which is inserted in orifices in each sleeve provided for such purpose. Moreover, the tilt of the blade may be modified by manually changing the length of either one or both of said push arms in appropriate fashion. For instance, where it is desired to change the pitch of the blade, both of the push arms are lengthened to increase forward pitch while both would be shortened to increase backward pitch. To change the tilt angle of the blade, one of the push arms is varied as to length while maintaining the other at a constant length, or alternatively, lengthening one push arm while shortening its counterpart. However, up to the present time, change in the length of the push arms is effected only by manual means, or in some instances by hydraulically powered modifications to the basic bulldozer structure.

Now, I have discovered a compact, efficient, electrically actuated and powered means for altering the tilt and/or pitch of bulldozer blades. My invention contemplates an easily installable, positively controllable, self-contained unit which is readily adaptable to many of the modern bulldozers in general use. It comprises an electric power means designed to rotate in either direction the rotatable member of the extensible compression unit forming one

of the push arms of the bulldozer to which it is attached. A geared speed reducing head and assembly is provided for transmitting power from the electric motor to the aforesaid rotatable member, whereby the length of the push arm can be varied quickly and to the desired amount simply by manipulating an electric switch conveniently located for immediate use by the operator.

It will now be apparent that but one of the aforesaid units is required to alter the tilt of a bulldozer blade, whereas two of said units may be installed in instances wherein it is desired to change the pitch as well as the tilt of the blade. Where it is appropriate to incorporate two units into a single bulldozer, each of the two push arms would be equipped with an individual unit; a right hand unit being provided for the push arm on the right hand side of the blade and a left hand unit for the left hand side.

The invention may be more fully understood by reference to the accompanying drawing which, for the purpose of clarity, illustrates a single preferred embodiment thereof. In Figure 1, grading blade or moldboard 21 is supported ahead of and impelled by tractor 22 by means of transversely spaced, forwardly extending lateral members or side arms 23 and 24 which are attached at their rearmost extremities to tractor 22 by ball and socket trunnions 26 wherein freedom of movement of said lateral members 23 and 24 is allowed. The fore ends of lateral members 23 and 24 are attached to grading blade 21 by pin coupling assembly 27. Semi-adjustable diagonal braces 28 are attached to the inboard side of lateral members 23 and 24 respectively by attaching pin arrangements 29. The foremost ends of diagonal braces 28 are coupled to the lower rear portion 31 of grading blade 21 by ball and socket joints 32.

Pulley assembly 33 is flexibly mounted to the rear portion of grading blade 21 and allows for the raising or lowering of blade 21 through manipulation of blade elevating lever 34 by the bulldozer operator. Rear end 36 of push arm 38 is flexibly mounted along the upper area of lateral member 23 by means of coupling 41, and rear end 37 of push arm 39 is likewise flexibly mounted along the upper area of lateral member 24 by means of coupling 42 which is similar in construction and operation to coupling 41.

A section of push arm 38 is illustrated in Figure 2 in fragmentary form to show rod 43 threadably engaged within sleeve 44 forming one of the paired extensible compression units indicated as push arms 38 and 39. Push arm 39 is fabricated similarly to its paired counterpart 38 and is connected to the upper rear portion 46 of grading blade 21 by means of ball and socket joint 48. Likewise, push arm 38 is attached to blade 21 by ball and socket joint 47.

It will be readily apparent that an increase in length of push arm 38 or push arm 39 while its paired counterpart is unaltered as to length, shortened or even increased in length to a lesser amount, will change the tilt angle of grading blade 21. For example, lengthening push arm 38 will cause an elevation of upper corner 49 of blade 21 and, through a slight warping effect of blade 21, will also cause a small degree of forward extension of upper corner 49. Moreover, increase in length of both push arms 38 and 39 will increase proportionally the forward pitch of blade 21, while decrease in length of said push arms will decrease the forward pitch or increase the backward pitch of blade 21.

In Figure 1, 51 indicates the housing for the tilting mechanism of the present invention. Said housing is shown as being welded to the upper rear portion 46 of grading blade 21 at upper corner 49 and shielding the foremost portion of push arm 38. Power transmission cable 52 for the electric motor of the blade tilting device supplies energy from the tractor battery (not shown) through on-off reversing switch 54 located on the handle of blade elevating lever 34.

Figure 2 is an enlarged top plan view of a preferred embodiment of the present invention, illustrating the arrangement and mode of mounting the various components of the blade tilting device. In Figure 2, means for rotating the rotatable member of the extensible compression unit integrated within push arm **38** is provided by electric motor **56** in combination with speed reducing gear head **57** and chain **58** interconnecting sprockets **59** and **61**. Driving sprocket **59** is of conventional manufacture and is attached to the output shaft of gear head **57**. Power recipient sprocket **61** is preferably fabricated in the form of diametrically split half sections to which attaching flanges **62***a* and **62***b* are rigidly fastened and is firmly mounted exteriorly to the rotatable member of push arm **38** by means of flange coupling bolts **63**. Motor **56** in combination with gear head **57** is pivotally attached to supporting bracket **64** by coupling **66** with rocker arm **67** which is rigidly attached at its rearmost end to reducing gear head **57** and pivotally secures motor **56** and gear head **57** to supporting bracket **64**. The foremost end of rocker arm **67** is held in position to assure proper tension of chain **58** by spring loaded coupling **68** positioned along stabilizing rod **69** firmly mounted to supporting bracket **64**. Supporting bracket **64** is detachably mounted to ball and socket joint **47** by means of retaining lugs **71** securing split attaching plate **72***a*—**72***b*, and is provided with upper and lower bracing struts **73**.

Actuation by the bulldozer operator of tilt-increasing button **76** in switch **54** causes electrical energy to operate electric motor **56** in conjunction with gear head **57** thereby imparting a clockwise rotational movement of driving sprocket **59** which movement is translated through chain **58** to recipient sprocket **61** and thence to the rotatable threaded sleeve of push arm **38** to which sprocket **61** is firmly mounted. Clockwise rotation of said grooved sleeve causes a proportional lengthening of push arm **38** forcing upwards and slightly forward the upper corner **49** of blade **21**, thereby increasing the tilt angle of said blade **21**. On the other hand, actuation of the tilt-decreasing button **77** in switch **54** results immediately in the downward and slightly backward movement of upper corner **49**, thereby decreasing the tilt angle of bulldozer blade **21**.

It will be appreciated that in certain instances an additional blade tilting unit may be mounted on the other top corner of the bulldozer blade for the automatic operation of the second push arm. This additional unit provides for electrically changing the pitch of the blade when the two units are conjointly operated. Moreover, an even speedier change in the tilt angle of the blade may then be accomplished by extending the first push arm while contracting the second, or vice versa. However, for the prime purpose of adjusting the tilt angle of the blade, only one automatic unit is required.

While various types of electric motors, reducing gear heads, sprockets and the like will suggest themselves to those skilled in the art of electrical power application, certain of these elements have been found in practice to perform very satisfactorily. For example, a 24 volt, 100 ampere, 2 horsepower motor with reduction gear head as manufactured by the General Electric Company of Schenectady, New York, for use aboard aircraft, is conveniently adapted to the tilting unit. However, depending on the size of the bulldozer and its battery power supply, electric motors of 6, 12 or 24 volt operation may be used. Variation in reduction gears and sprocket sizes may be made depending on the power output of the motor and the speed desired in altering the tilt angle of the blade. While it is contemplated to provide a more or less standardized unit applicable to most modern bulldozers of acceptacle design, the components and structure of the blade tilting device may be appropriately varied in accordance with the specific requirements of the particular bulldozer in which it is to be integrated as an operating unit thereof.

It has been found in practice that an ideal location for the electric reversing on-off switch actuating the blade tilting device is on the elevating arm which controls the raising or lowering of the bulldozer blade through actuation of the mechanical pulley hoist as indicated in the drawing, or in some cases through actuation of hydraulic blade supporting means. This elevating arm is conveniently positioned for ready manipulation by the bulldozer operator and, as a matter of fact, is often held in the hand of the operator for long periods during grading operations. However, depending on other considerations such as, for example, personal preference, the switch may be conveniently mounted elsewhere near the other controls. The suggested electric switch comprises a three button arrangement providing for increasing pitch, decreasing pitch and stopping the electric motor. Other types of switches or combinations thereof, depending on whether two blade tilting units are used instead of one, can be installed to perform satisfactorily.

Although a split type power recipient sprocket for attachment to the rotatable member of a push arm is suggested as a preferred embodiment of the invention, one of unitary construction having a centrally located orifice and appropriate attaching means may be used; but disadvantageously requiring a dismounting of the push arm in order to slip said sprocket over said push arm. Moreover, while the invention embodies the use of a split plate **72***a*—**72***b* for attaching the power unit to ball and socket joint **47** without disassembling push arm **38** from the grading blade, this attaching plate may also be of unitary design although such construction increases the installation details as in the case of a unitary sprocket already mentioned.

The blade tilting unit is attached to the blade by welding or bolting the housing to the upper rear portion of said blade. The housing is conveniently fabricated with a detachable cover plate which protects the blade tilting device from potential damage resulting from possible collision with rocks, stones or other debris, while at the same time permitting easy access to its operating components.

While in the foregoing the term "bulldozer" is used in its conventional sense to indicate a tractor driven earth working machine, the invention is adaptable to other types of machinery equipped with a grading blade and having appropriately designed push arms for altering the tilt or pitch of said grading blade. Moreover, the terms "blade," "grading blade," "moldboard" and the like are used interchangeably herein, and refer to that leading, transversely positioned component of the earth working equipment which actually digs into, gouges, planes, scrapes, grades or otherwise similarly comes into contact with the terrain.

While the salient features of this invention have been described in detail with respect to certain embodiments thereof, it will of course be apparent that certain modifications may be made within the spirit and scope of this invention, and it is not desired therefore to limit the invention to the exact details shown except insofar as they may be defined in the following claims.

I claim:

1. In a bulldozer assembly of the type described having a pair of extended side arms with a grading blade pivotally mounted at the extended ends of such arms, the combination comprising a pair of telescopically extensible units, each of said units having a threaded rod pivotally secured at one end to one of said side arms and an internally threaded sleeve engaging said rod with an extended end rotatably and pivotally secured to said blade, and an electric motor mounted on said blade with a mechanical coupling extended between the drive shaft of said motor and said sleeve of at least one of said units to control the length and provide an in-line force along said unit between said side arm and blade; said mechanical coupling comprising a speed reducing gear

head, the output shaft of said motor coupled to said gear head and providing input power to said gear head, a driving sprocket attached to the output shaft of said gear head, and a driving chain engaging the teeth on said driving sprocket and likewise the teeth on a power recipient sprocket formed for mounting on the rotatable sleeve of at least one of the extensible units.

2. In a bulldozer assembly of the type described having a pair of extended side arms with a grading blade pivotally mounted at the extended ends of such arms, the combination comprising a pair of telescopically extensible units, each of said units having a threaded rod pivotally secured at one end to one of said side arms and an internally threaded sleeve engaging said rod with an extended end rotatably and pivotally secured to said blade, and a motor mounting for an electric motor secured to said blade with a mechanical coupling extended between the drive shaft of said motor and said sleeve of at least one of said units to control the length and provide an in-line force along said unit between said side arm and blade; said motor mounting and mechanical coupling comprising a speed reducing gear head coupled to the output shaft of said motor and the output shaft of said gear head coupled to a driving sprocket, and a driving chain interconnecting said driving sprocket with a power recipient sprocket formed for attachment to the rotatable sleeve of at least one of the extensible units, and said motor and gear head formed for pivotal attachment in conjunction with a spring loaded rocker arm to a supporting bracket formed for mounting to the bulldozer assembly, whereby said driving chain is maintained in taut condition.

3. In a bulldozer assembly of the type described having a pair of extended side arms with a grading blade pivotally mounted at the extended ends of such arms, the combination comprising a pair of telescopically extensible units, each of said units having a threaded rod pivotally secured at one end to one of said side arms and an internally threaded sleeve engaging said rod with an extended end rotatably and pivotally secured to said blade, and a motor mounting for an electric motor secured to said blade with a mechanical coupling extended between the drive shaft of said motor and said sleeve of at least one of said units to control the length and provide an in-line force along said unit between said side arm and blade; said motor mounting and mechanical coupling comprising a speed reducing gear head coupled to the output shaft of said motor, a driving sprocket mounted on the output shaft of said speed reducing gear head, a driving chain engaging the teeth on said driving sprocket and likewise engaging the teeth on a power recipient sprocket formed for mounting on the rotatable sleeve of at least one of the extensible units, a pivotal coupling formed for attaching said motor and speed reducing gear head in conjunction with a rocker arm to a supporting bracket formed for firm attachment to the bulldozer assembly, and said rocker arm formed to be held at its distal extremity by a spring loaded coupling extending along a stabilizing rod firmly mounted to said supporting bracket, whereby said driving chain is maintained in taut condition by said rocker arm.

4. In a bulldozer assembly of the type described having a pair of extended side arms with a grading blade pivotally mounted at the extended ends of such arms, the combination comprising a pair of telescopically extensible units, each of said units having a threaded rod pivotally secured at one end to one of said side arms and an internally threaded sleeve engaging said rod with an extended end rotatably and pivotally secured to said blade, and a motor mounting for an electric motor secured to said blade with a mechanical coupling extended between the drive shaft of said motor and said sleeve of at least one of said units to control the length and provide an in-line force along said unit between said side arm and blade; said motor mounting and mechanical coupling comprising a speed reducing gear head coupled to the output shaft of said motor, a driving sprocket mounted on the output shaft of said speed reducing gear head, a driving chain engaging the teeth on said driving sprocket and likewise engaging the teeth on a power recipient diametrically split sprocket formed for mounting on the rotatable sleeve of at least one of the extensible units, a pivotal coupling formed for attaching said motor and speed reducing gear head in conjunction with a rocker arm to a supporting bracket formed for firm attachment by means of a split attaching plate to the bulldozer assembly, and said rocker arm formed to be held at its distal extremity by a spring loaded coupling extending along a stabilizing rod firmly mounted to said supporting bracket, whereby the power means may be mounted to the bulldozer assembly without dismantling substantially the extensible unit from the bulldozer assembly and whereby said driving chain is maintained in taut condition by said rocker arm.

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