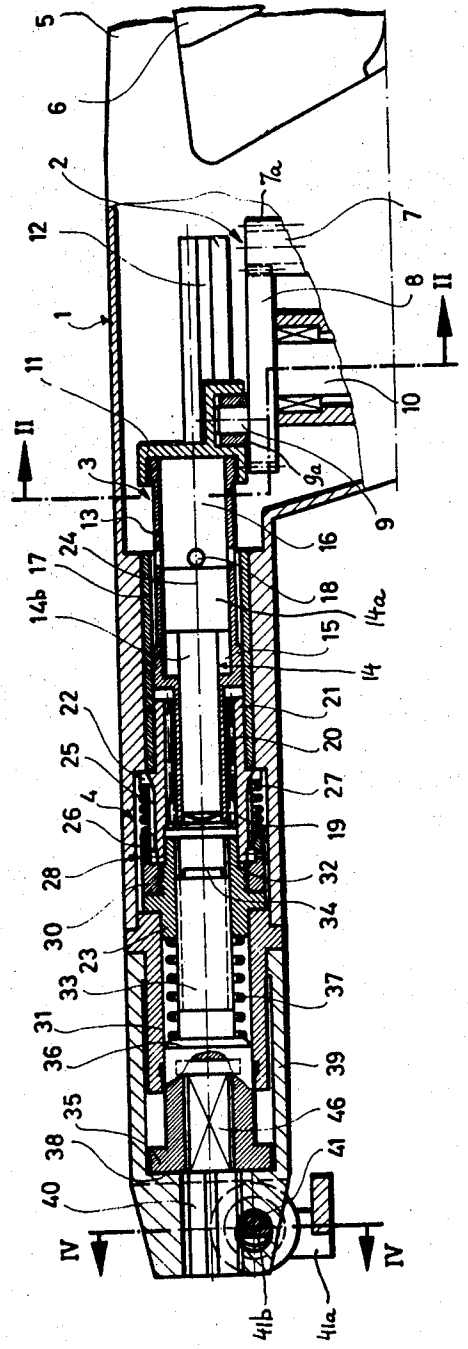
Aug. 26, 1969 H. BRONNERT 3,463,246

ROTARY PERCUSSIVE POWER TOOL WITH CHANGEABLE DRIVE

Filed Dec. 27, 1967 2 Sheets-Sheet 1

Fig. 1



INVENTOR

Helmut Bronnert

BY Michael S. Striker

ATTORNEY

Aug. 26, 1969 H. BRONNERT 3,463,246

ROTARY PERCUSSIVE POWER TOOL WITH CHANGEABLE DRIVE

Filed Dec. 27, 1967 2 Sheets-Sheet 2

Fig. 2

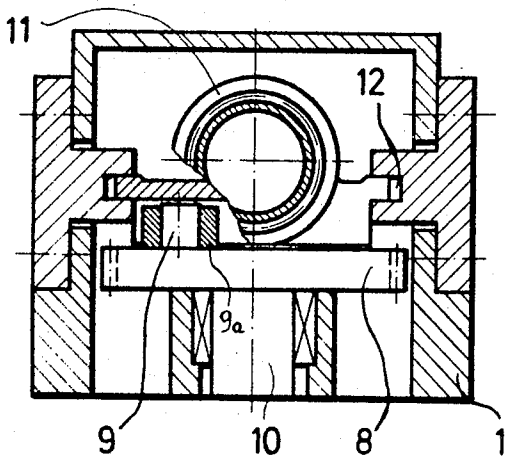


Fig. 3

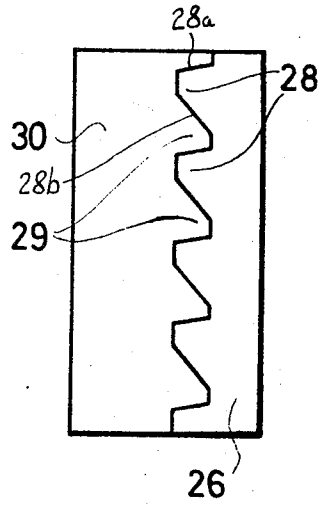


Fig. 4

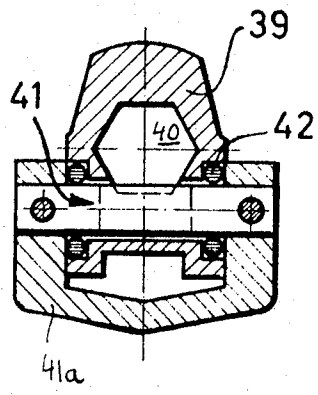


Fig. 5

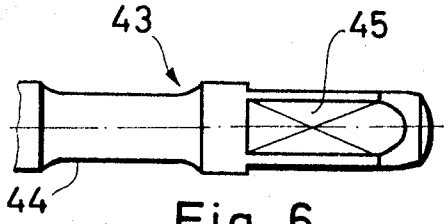
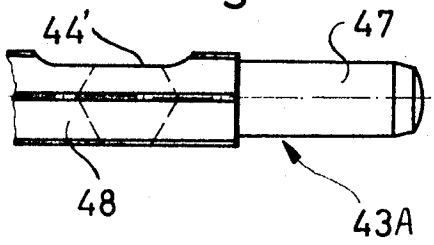


Fig. 6



INVENTOR

Helmut Bronnert

BY Michael S. Striker

ATTORNEY

United States Patent Office 3,463,246
Patented Aug. 26, 1969

3,463,246

ROTARY PERCUSSIVE POWER TOOL WITH CHANGEABLE DRIVE

Helmut Bronnert, Stuttgart-Rohr, Germany, assignor to Metabowerke KG. Closs, Rauch & Schnizler, Nurtingern, Wurttemberg, Germany

Filed Dec. 27, 1967, Ser. No. 693,842
Claims priority, application Germany, Dec. 28, 1966, M 72,222
Int. Cl. E21c 3/04; B25d 9/04, 9/06
U.S. Cl. 173—47 20 Claims

ABSTRACT OF THE DISCLOSURE

A power tool wherein the barrel of a housing accommodates a cylinder which is reciprocable axially in response to rotation of the output shaft of a motor and thereby turns back and forth a sleeve which is held in the housing against axial movement and transmits torque to a first clutch element which is biased against a second clutch element. The latter can rotate in one direction an axially movable tool holder which can be shifted axially of the housing to place its anvil into the range of reciprocatroy movement of a ram which is movable axially with and relative to the cylinder. The holder can accommodate tools which are rotatable therewith or are held against rotation by a suitably configurated portion of the housing. The first clutch element is automatically disengaged from the second clutch element when the latter offers excessive resistance to rotation in the one direction.

Background of the invention

The present invention relates to power tools in general, and more particularly to improvements in implements of the type which can be used to rotate and/or to transmit axially oriented impacts to boring, drilling, chiseling or like tools.

In certain presently known power operated implements, the work-engaging tool is rotated in one direction in response to dissipation of energy by helical springs which also serve to prevent rotation of the tool in the other direction. The springs are likely to break when the tool offers excessive resistance to rotation and, if the bias of such springs is too strong, the implement is likely to break and to cause injury to the operator or to persons standing nearby. If the bias of springs is too weak, the usefulness of the implement is limited because the user is unable to drive a tool into or to remove material from a relatively hard or tough workpiece. Such implements are disclosed, for example, in German Utility Model No. 1,928,513.

It is also known to provide a power operated implement with a pneumatically actuated impact transmitting unit which strikes against one end of the tool. Such implements are disclosed, for example, in German Utility Model No. 1,196,608 and their drawback is that the transmission which is employed to rotate the tool is too bulky, too expensive and prone to malfunction. The tool is rotated continuously.

Summary of the invention

It is an object of my invention to provide a simple, rugged and inexpensive power tool or implement which can transmit to a material-penetrating or material-removing tool torque and/or axially oriented impacts in a novel and improved way.

Another object of the invention is to provide an implement wherein the tool can be rotated stepwise and wherein the user of the implement can determine the magnitude of impacts which are transmitted to the tool.

A further object of the invention is to provide an implement which can be used solely as a means for effecting stepwise rotation of a tool or solely as a means for transmitting to the tool a series of axially oriented impacts of variable magnitude.

An additional object of the invention is to provide an implement wherein the tool receives impacts only at such times when it does not receive torque, or vice versa.

A concomitant object of the invention is to provide an implement wherein the tool is automatically disengaged from the torque transmitting means when it offers excessive resistance to rotation and wherein the exact resistance at which the transmission of torque ceases can be changed at the option of the user.

Still another object of the invention is to provide an implement wherein the parts which guide and support the impact transmitting means are protected against excessive wear and/or breakage.

A further object of the invention is to provide an implement which can embody an electrically operated or fluid operated prime mover.

Another object of the invention is to provide a novel driving assembly which can effect intermittent axial and/or rotary movements of a tool.

A further object of the invention is to provide a novel clutch which can transmit torque from the driving assembly to the holder of a material penetrating and/or material removing tool.

An additional object of my invention is to provide an implement which can be operated by semiskilled persons, which is not likely to cause injury to the user or damage to a workpiece, and which can stand long periods of use and is more efficient than the aforediscussed conventional implements.

The improved implement comprises a housing, a driver assembly mounted in the housing and reciprocable axially in response to motion received from an electric or fluid-operated prime mover, a tubular member rotatably mounted in the housing, coupling means preferably comprising mating steep threads provided on the driver assembly and on the tubular member to turn the latter back and forth in response to reciprocation of the driver assembly, disengageable clutch means including a first element connected for rotation with the tubular member, a second element rotatable in the housing, and biasing means for urging one of the elements against the other element so as to maintain teeth provided on the one element in mesh with complementary teeth provided on the other element and to permit the teeth to move apart if the second element offers excessive resistance to rotation with the first element, and an axially movable tool holder connected for rotation with the second element and having an impact receiving portion or anvil movable into the range of the driver assembly so that a tool which is mounted in the holder can be rotated by the latter if it is non-rotatably secured thereto, that such tool can be moved axially in response to impacts transmitted to the holder if the latter's anvil is placed into the range of the driver assembly, or that the tool is rotated during intervals between successive impacts against the anvil.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved power tool itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

Brief description of the drawing

FIG. 1 is a fragmentary axial sectional view of a portable power tool which embodies my invention;

FIG. 2 is an enlarged transverse sectional view as seen

in the direction of arrows from the line II—II of FIG. 1;

FIG. 3 is an enlarged developed view of a portion of a clutch in the power tool of FIG. 1;

FIG. 4 is an enlarged transverse sectional view as seen in the directional of arrows from the line IV—IV of FIG. 1;

FIG. 5 is a fragmentary side elevational view of a first tool which can be used in the structure of FIG. 1; and

FIG. 6 is a similar fragmentary side elevational view of a second tool.

Description of the preferred embodiments

FIG. 1 illustrates a portion of a portable power tool comprising a housing **1** having a pistol grip type handle **5** which accommodates a suitable prime mover whose rotary output shaft is shown at **7**. The latter drives a single-stage step-down transmission **2** which serves to convert rotary movement of the shaft **7** into reciprocatory movement of a driver assembly **3**. The handle **5** has an actuating member **6** e.g., an electric switch or a valve actuator, depending upon whether the prime mover is an electric motor or a fluid-operated motor.

The transmission **2** includes a pinon **7***a* which can form an integral part of the output shaft **7** and meshes with a gear **8** mounted on a shaft **10** which is journalled in the housing **1**. The gear **8** is provided with an eccentric pin **9** for a roller **9***a* extending into a transverse slot in a carriage **11** which forms part of the driver assembly **3** and is reciprocable in ways **12** provided in the rear portion of the housing **1**. The arrangement is such that the carriage **11** reciprocates along the ways **12** in response to rotation of the output shaft **7**. The driver assembly **3** further includes an elongated cylinder **13** which is threadedly connected with the carriage **11** and has a larger-diameter intermediate portion slidable in a bearing sleeve **17** of the housing **1**. The cylinder **13** accommodates the rear end portion or piston **14***a* of an impeller or ram **14** whose stem or rod **14***b* is slidably guided in and can extend forwardly beyond the smaller-diameter front end portion of the cylinder. The piston **14***a* divides the interior of the cylinder **13** into two air-filled chambers **15**, **16** wherein the bodies of air act not unlike cushions to prevent the ram from striking with excessive force against the carriage **11** and/or against the shoulder between the median and front end portions of the cylinder **13**. The latter is provided with one or more substantially centrally located airflow restricting openings **18** which can admit air to the chambers **15**, **16** in order to compensate for eventual leakage when the ram **14** moves back and forth.

The front end portion of the cylinder **13** is provided with a set of steep external threads **19** meshing with internal threads **20** of a tubular member or sleeve **21** which turns back and forth in response to reciprocation of the cylinder but is held against axial movement by the bearing sleeve **17** and housing **1** (the rear portion of the sleeve **21** has one or more outwardly extending projections **22** which bear against the front end face of the bearing sleeve **17** and against an internal shoulder of the housing **1**) as well as by an annular socket **23** which is mounted in the housing in such a way that it cannot move axially. The common axis of the cylinder **13** and of the barrel of the housing **1** is shown at **24**. The threads **19**, **20** form a simple coupling which converts axial movements of the driver assembly **3** into rotary movements of the sleeve **21**. The external surface of the sleeve **21** is formed with axially parallel splines **25** receiving internal ribs provided on a ring-shaped clutch element **26** which forms part of a clutch **4**. Thus, the clutch element **26** is movable axially with reference to the sleeve **21** but cannot rotate thereon. A prestressed clutch spring **27** is inserted between the projection or projections **22** and the clutch element **26** to bias the latter forwardly toward the working end of the power tool.

As shown in FIG. 3, the front end face of the clutch element **26** is formed with an annulus of saw teeth **28** each having a substantially axially extending flank **28***a* and a more pronouncedly inclined flask **28***b*. The flanks **28***a*, **28***b* of each tooth **28** make an acute angle. A second or complementary clutch element **30** of the clutch **4** has complementary saw teeth **29** which normally mesh with the teeth **28** in a manner as shown in FIG. 3. The clutch element **30** is threadedly connected with the socket **23**, i.e., the latter can be considered as forming part of the clutch element **30** or vice versa. The socket **23** is rotatable on an annular insert **31** of the housing **1** and has internal splines **32** for external ribs provided on a tool holder **33** which is movable therein in the axial direction of the housing. The rear portion **34** of the holder **33** constitutes an impact receiving anvil and can be struck by the stem **14***b* of the ram **14** when the latter performs a forward stroke. The front portion of the holder **33** is formed with a flange **35** located in front of a central portion **36** whose diameter exceeds the diameter of the ribbed rear end portion. A prestressed helical spring **37** is inserted between the socket **23** and central portion **36** to bias the holder **33** forwardly so as to normally maintain the flange **35** in abutment with an internal stop surface **38** provided on the front end portion **39** of the housing **1**. As shown in FIGS. 1 and 4, the front end portion **39** of the housing **1** accommodates a transversely extending retaining bolt **41** which is mounted in elastic bearing rings **42**. The peripheral surface of the bolt **41** has a flat **41***b* which can be moved into parallelism with the axis **24**. To this end, the bolt **41** is connected with a manually operable yoke **41***a* which, when moved to the position shown in FIG. 1, holds the flat **41***b* in a plane which is normal to the axis **24**. When the flat **41***b* is parallel with this axis, the operator can insert into the hexagonal bore **40** of the front end portion **39** the shank of a drilling or boring tool **43** shown in FIG. 5. The shank is also provided with a flat so that it can bypass the bolt **41** when the flat **41***b* is parallel to the axis **24**. FIG. 5 shows that the drilling or boring tool **43** is provided with a shank **45** of square cross-section outline. The shank **45** can extend into the complementary bore **46** of the holder **33** so that the tool of FIG. 5 is compelled to rotate with the clutch element **30** when the latter receives torque from the clutch element **26**. A smaller-diameter portion **44** of the tool **43** is engaged by the bolt **41** when the latter assumes the position shown in FIG. 1 and thus holds the tool against ejection from the front end portion **39** of the housing **1**. FIG. 6 shows a chisel **43A** whose shank **47** is round and a median portion **48** of which is hexagonal so that it is non-rotatably receivable in the hexagonal bore **40** of the front end portion **39**. Thus, the tool **43A** of FIG. 6 can be moved axially but cannot rotate with the holder **33**. The portion **48** has a depression **44'** which receives a portion of the bolt **41** when the latter assumes the angular position shown in FIGS. 1 or 4.

The operation is as follows:

When the user applies pressure against the actuating member **6**, the shaft **7** of the prime mover rotates the gear **8** whereby the roller **9***a* orbits about the axis of the shaft **10** and moves the carriage **11** and cylinder **13** back and forth with reference to the barrel of the housing **1**. The arm **14** shares at least some axial movements of the cylinder **13** whereby the cushions of air in the chambers **15**, **16** prevent the piston **14***a* from striking the cylinder **13** and carriage **11** with an excessive force. The steeply inclined threads **19**, **20** cause the sleeve **21** to turn back and forth about the axis **24**. For example, the sleeve **21** can turn in a clockwise direction when the cylinder **13** performs a forward stroke in a direction toward the front portion **39** of the housing **1**. The splines **25** cause the clutch element **26** to rotate with the sleeve **21** and the flanks **28***a* of teeth **28** on the clutch element **26** rotate the teeth **29** of the clutch element **30** when the clutch element **26** turns in a clockwise direction. When the clutch element **28** turns in a counterclockwise direction, the in-

clined flanks 28*b* of teeth 28 slide along the teeth 29 of the clutch element 30 against the opposition of clutch spring 27. Thus, and if the shank 45 of the tool 43 shown in FIG. 5 is inserted into the bore 46 of the holder 33, the tool 43 is rotated stepwise in a clockwise direction but does not rotate in a counterclockwise. The holder 33 receives torque from the internal splines of the socket 23 which rotates with the clutch element 30.

Whether or not the 43 receives axial impulses from the ram 14 depends on the axial position of the anvil 34 with reference to the stem 14*b* of the ram when the latter approaches the end of or completes a forward stroke toward the end portion 39. The holder 33 can be moved axially toward the cylinder 13 in response to pressure transmitted thereto by the tool 43, i.e., the tip of the tool can be pressed against a workpiece with a force which sufficies to overcome the resistance of the spring 37 and to shift the holder 33 and its anvil 34 toward the ram 14. When the holder 33 assumes the foremost axial position shown in FIG. 1, the stroke of the ram 14 is too short so that the stem 14*b* cannot strike against the anvil 34. The force of blows transmitted by the ram 14 depends on the extent to which the spring 37 is compressed, i.e., on the extent of axial displacement of the flange 35 away from the stop surface 38 of the front end portion 39.

If the tool 43 meets an excessive resistance to rotation in the clockwise direction, the clutch element 26 begins to turn with reference to the clutch element 30 when the sleeve 21 turns in either direction. This is made possible by the slight inclination of tooth flanks 28*a* with reference to the axis 24 (see FIG. 3). Thus, the clutch 4 is a safety clutch which is disengaged in automatic response to excessive resistance offered by holder 33 to rotation of the clutch element 30. This feature insures that the parts of the apparatus are protected against damage and prevents injury to the operator or to persons standing nearby.

When the user replaces the tool 43 with the tool 43A of FIG. 6, the shank 47 cannot be rotated by the holder 33 but the user can drive the tip of the tool 43A into wood or other material if the holder 33 is moved axially rearwardly against the opposition of spring 37 to place its anvil 34 into the range of the stem 14*b*. The hexagonal median portion 48 of the tool 43A is then non-rotatably received in the bore 40 of the front end portion 39.

The ram 14 preferably strikes the anvil 34 upon completed rotation of the holder 33, i.e., when the cylinder 13 reaches the forward end of its stroke and the ram travels forwardly due to inertia and against the opposition of air cushion in the chamber 15.

An important advantage of my power tool is that reciprocatory movements of the driver assembly 3 are converted into rotary movements of the clutch elements 26, 30 in a very simple and space-saving manner. Furthermore, one component (ram 14) of the driver assembly 3 also serves as a means for transmitting impacts to the holder 33 for the tool 43, 43A or another tool. The force of such impacts can be regulated by the user in a very simple way and excessively resistance offered by the tool 43 to rotation results in automatic disengagement of the clutch 4 to prevent damage or injury. The parts of my power tool can be made sufficiently rugged to withstand extensive and repeated use, and the bias of the clutch spring 27 can be adjusted (or this spring can be replaced by a different spring) if the user wishes to select a different resistance which leads to disengagement of the clutch 4. Similar results can be achieved by replacing the clutch elements 26, 30 with clutch elements whereon the inclination of flanks 28*a* and/or 28*b* is different from that shown in FIG. 3.

The spring 27 is stressed sufficiently to prevent rebounding of clutch element 26 during rotation in a colckwise direction so that this element can drive the clutch element 30 and holder 33 as long as the cylinder 13 moves forwardly.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In a power tool for rotating and/or transmitting axially oriented impacts to drilling, boring, chiseling or like tools, a combination comprising a housing; a driver assembly mounted in and reciprocable axially of said housing; a tubular member rotatably mounted in said housing; coupling means provided on said tubular member and on said driver assembly to turn the tubular member back and forth in response to reciprocation of said assembly; disengageable clutch means including a first element connected for rotation with said tubular member, a second element rotatable in said housing, and biasing means for urging one of said elements axially against the other element, said elements having complementary teeth arranged to transmit torque from said first to said second element in at least one direction and to move apart against the opposition of said biasing means when the resistance offered by said second element to rotation with said first element in said one direction exceeds a given value; and an axially movable tool holder connected for rotation with said second element and having an impact receiving portion movable into the range of said driver assembly.

2. A combination as defined in claim 1, wherein said coupling means comprises steep threads provided on said driver assembly and complementary steep threads provided on said tubular member.

3. A combination as defined in claim 1, wherein the teeth of said elements of said clutch means resemble saw teeth.

4. A combination as defined in claim 1, wherein said second element of said clutch means comprises a socket axially movably accommodating said impact receiving portion of said tool holder.

5. A combination as defined in claim 1, wherein said driver assembly comprises a cylinder movable axially in said housing and a ram movable axially with and relative to said cylinder.

6. A combination as defined in claim 5, wherein said ram comprises a portion dividing the interior of said cylinder into a pair of air-filled chambers wherein the air opposes axial movements of said ram relative to said cylinder.

7. A combination as defined in claim 6, wherein said ram comprises a second portion extending from said cylinder and arranged to strike against said impact receiving portion when said tool holder is moved axially toward and sufficiently close to said driver assembly.

8. A combination as defined in claim 6, wherein said cylinder has at least one air flow restricting opening connecting said chambers with the atmosphere.

9. A combination as defined in claim 5, wherein said cylinder has a smaller-diameter front portion adjacent to said clutch means and surrounded by said tubular member, said coupling means comprising steep external threads provided on said front portion and steep internal threads provided on said tubular member and meshing with said external threads.

10. A combination as defined in claim 1, wherein said tubular member is formed with axially extending splines receiving projections provided on said first element of said clutch means so that said first element is movable axially of said tubular member.

11. A combination as defined in claim 10, wherein said biasing means comprises resilient means operating between said tubular member and said first element to urge the latter axially toward and against said second element of said clutch means.

12. A combination as defined in claim 1, further comprising a socket rigid with said second element of said clutch means and axially movably accommodating a portion of said tool holder.

13. A combination as defined in claim 1, wherein the teeth of said elements of said clutch means have flanks making an acute angle with the axis of said housing.

14. A combination as defined in claim 1, further comprising second biasing means for urging said tool holder away from said tubular member to normally maintain said impact receiving portion outside of the range of said driver assembly.

15. A combination as defined in claim 14, wherein said housing comprises stop means and said tool holder normally abuts against said stop means under the action of said second biasing means.

16. A combination as defined in claim 1, further comprising retaining means provided on said housing adjacent to said tool holder and movable into retaining engagement with a tool which is inserted into said holder.

17. A combination as defined in claim 16, wherein said retaining means comprises a bolt turnable in elastic bearings provided therefor in said housing.

18. A combination as defined in claim 1, wherein said driver assembly comprises a carriage reciprocable in ways provided therefor in said housing and having a transversely extending slot, and further comprising means

for reciprocating said carriage including a driven member rotatable about a second axis which is substantially normal to the axis of said housing and having an eccentric portion extending into said slot.

19. A combination as defined in claim 18, wherein driven member forms part of a transmission and further comprising a prime mover having an output portion mounted in said housing and operatively connected with said transmission.

20. A combination as defined in claim 1, wherein said one element is said first element of said clutch means and said biasing means comprises a helical spring operating between said first element and an external projection of said tubular member.

References Cited

UNITED STATES PATENTS

2,700,373	1/1955	Feucht	173—111
3,029,672	4/1962	Löwenborg	173—111
3,275,088	9/1966	Schröttle	173—110

JAMES A. LEPPINK, Primary Examiner

U.S. Cl. X.R.

173—110, 111