(No Model.) 2 Sheets—Sheet 1.

H. BICKFORD & A. ARMITAGE.

CHANGEABLE SPEED GEARING.

No. 307,002. Patented Oct. 21, 1884.

Fig. 1.

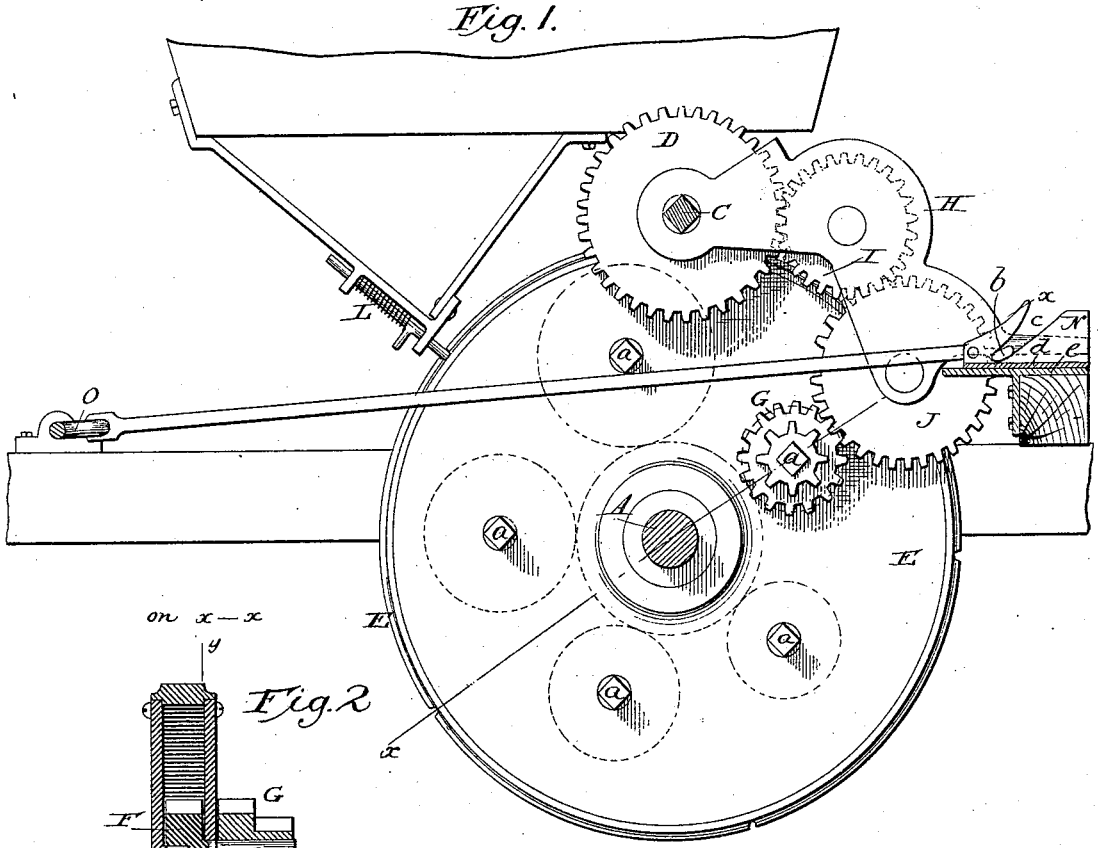


Fig. 2

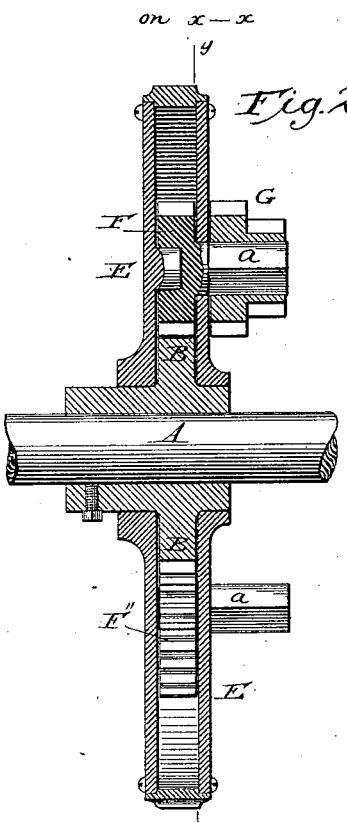
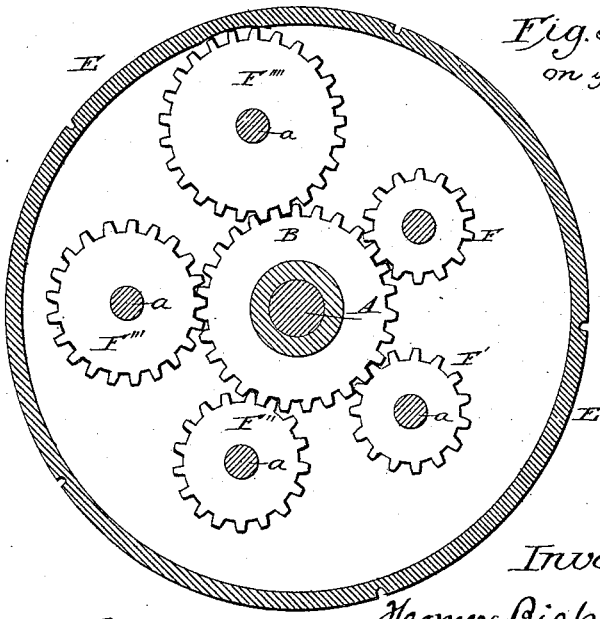


Fig. 3.
on y-y



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(No Model.) 2 Sheets—Sheet 2.

H. BICKFORD & A. ARMITAGE.

CHANGEABLE SPEED GEARING.

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Fig. 4.
on 3-3

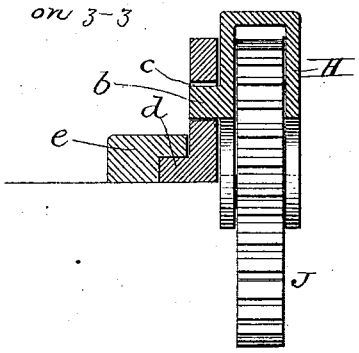


Fig. 5

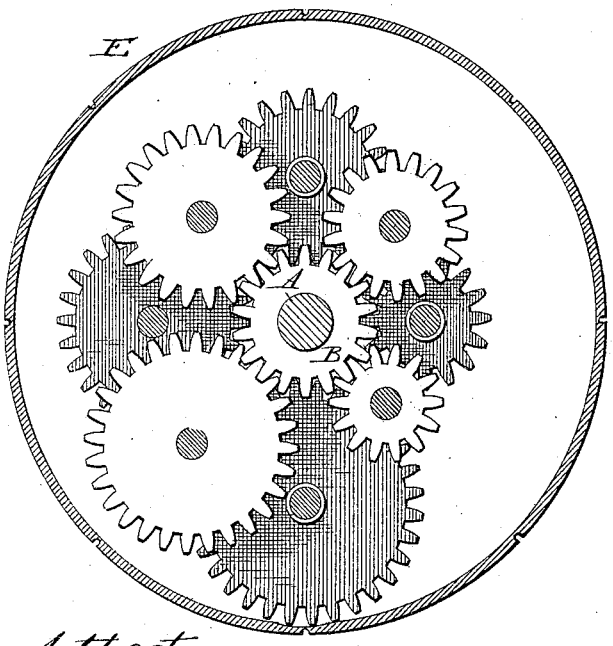
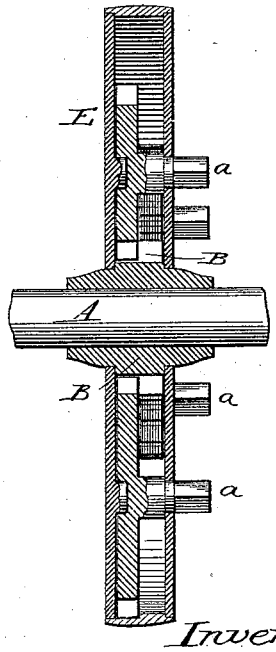


Fig. 6



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Atty.

UNITED STATES PATENT OFFICE.

HOMER BICKFORD, OF MACEDON, AND ALBERT ARMITAGE, OF LYONS, N. Y.

CHANGEABLE SPEED GEARING.

SPECIFICATION forming part of Letters Patent No. 307,002, dated October 21, 1884.

Application filed September 8, 1884. (No model.)

To all whom it may concern:

Be it known that we, HOMER BICKFORD, of Macedon, in the county of Wayne and State of New York, and ALBERT ARMITAGE, of Lyons, in the same county and State, have invented certain Improvements in Changeable Speed Gearing, of which the following is a specification.

This invention relates to improvements in that class of changeable speed gears in which the intermediate pinions of the gear-train are mounted in a revolving shell or support in such manner as to remain in constant engagement with a central driving-pinion, so that by the revolution of the case or support they may be brought one after another in position for operation, as may be demanded.

The present invention relates more particularly to improvements on the changeable speed gear set forth in the application of Albert Armitage executed and filed of even date herewith.

The invention relates to an improved arrangement of devices for throwing the driven pinions into and out of gear, to a reversible pinion by means of which the changes of speed may be increased, and to other details of secondary importance, hereinafter described.

Referring to the accompanying drawings, Figure 1 represents a side elevation of our improved system of gearing. Fig. 2 is a vertical section of the same on the line *x x*. Fig. 3 is a vertical section on the line *y y* of Fig. 2. Fig. 4 is a cross-section on the line *z z* of Fig. 1. Figs. 5 and 6 are views representing the device in a slightly-modified form.

Referring to the drawings, A represents the driving-shaft mounted in stationary bearings, and provided with a driving-pinion, B, fixed thereon.

C represents the shaft to be driven, which in the present case is also mounted in fixed bearings and provided with a pinion, D.

Loosely around the driving-shaft A we mount a hollow cylindrical support or shell, E, containing a number of pinions, F F′ F″, &c., of different diameters, grouped around the driving-pinion B, and driven therefrom constantly and at different speeds corresponding to their diameters. Each of these central pinions has a shaft or spindle, *a*, seated in the shell or support and projecting through the same on one side. These projecting spindles are made of a square form at the outer end, as shown, or otherwise adapted to permit of the convenient and secure application of the pinion G, which may be changed at will from one spindle to another.

For the purpose of throwing the driving-train into and out of connection, we mount around the shaft C a swinging arm or support, H, carrying two pinions, I and J, which gear constantly with each other, and the former of which also engages constantly with the pinion D. On revolving the carrier or shell E one or another of the secondary pinions may be brought into such position that the pinion G on its spindle may engage the pinion I, and thereby transmit motion through the pinion I to the pinion D.

It will be readily perceived that when the parts are in action motion is imparted through the secondary pinion F, and from the spindle of the latter to the external pinion, G, and thence, through the pinions J and I, to the pinion D.

Inasmuch as the secondary pinions F F′, &c., by reason of their different diameters, are driven at different speeds from the central pinion, it follows that the rotation of the carrier E, so as to bring one or another of the secondary pinions into position to drive pinion G, will be followed by a corresponding change in the speed of the driven shaft C. The smaller the pinion which is brought into active operation the higher the speed of the shaft C, and vice versa. While the entire series of secondary pinions within the shell or support remain constantly in gear with the central pinion, it is to be noted that with the exception of the one in action they run freely and without appreciable wear or friction. In other words, the power, instead of being transmitted through the entire series of secondary pinions, is applied only to the one which is for the time being in active use.

While the changing of the pinion G from one to another of the spindles *a* as they are successively brought into action is described above, and while this plan is preferred for the sake of simplicity and cheapness, it is, however, understood that each spindle may have its own pinion G fixed firmly thereon. In such case the pinions G may be of the same or of

different diameters, as preferred. If they be made of different diameters, the internal or secondary pinions may be of uniform diameter, as the change in speed will be secured by the difference in size of the external pinions. This will permit the speed to be changed instantly without first shifting the pinion.

In order to secure the proper action of the mechanism, it is of course requisite that the shell or pinion-support E should be held stationary, except at the moment of changing adjustment. To this end it is proposed to provide locking devices of any suitable character; but we recommend as the most simple arrangement for the purpose a sliding bolt or dog, L, mounted in a fixed guide and urged downward by a spring into notches in the periphery of the shell or support. There are a number of these notches so located that when in connection with the dog they will present and hold the respective spindles at the proper point for operation. It will of course be understood that the revolving shell is merely a rotary support, by means of which one or another of the various secondary pinions may be conveniently brought to a position for action.

For the purpose of throwing the driving-train into and out of gear at will we provide the swinging arm H on one side with a projecting stud, *b*, which enters an angular slot, *c*, formed in one end of a slide, N, connected at one end to a crank or rock shaft, O. Vertical motion of the slide is prevented by a lip, *d*, formed on its side and engaging under a flange or guide, *e*, on the frame, as shown in Fig. 4. The movement of the slide in one direction has the effect of lifting the arm H and throwing the pinion J out of engagement with the pinion G, while the movement of the slide in the opposite direction has the effect of throwing the pinion J into action and of locking the parts in such manner as to prevent the disconnection of the pinion. While this constitutes a simple and effective means of adjusting the frame, it is to be understood that we may substitute therefor any equivalent adjusting devices.

For the purpose of affording an additional number of changes in the speed of the driven shaft, we propose to make the pinion G with a broad face and of different diameters, so that by reversing or turning it side by side upon the spindle its larger or smaller portion may be brought into engagement with the pinion J. When the large side of the pinion is in use, the driven shaft will receive its highest speed.

In Figs. 2 and 3 we have represented a single series of secondary pinions, F F′, &c., arranged in the same vertical plane. When it is desired to employ a large number of pinions to afford an increased number of changes in the speed of the shaft, we propose to arrange the pinions in two series located in different vertical planes, as shown in Figs. 5 and 6. In this arrangement the pinions in one series may overlap those in the other, and thus a large number of pinions may be placed within a shell or support of small diameter. When this construction is adopted, the central pinion will be of sufficient width to engage above one series of secondary pinions, as shown in Fig. 6. When this wide pinion is used, it may be of equal diameter across its entire face; or its two sides may be of different diameters.

While we prefer to employ the shell or support for the secondary pinion in the form of a hollow case or drum, as represented in the drawings, for the reason that it serves to protect the pinions from dust and other obstructive matters, it will of course be understood that the form may be changed to any extent desired, the only essential requirement being that the support be adapted to sustain the several pinions in constant engagement with the driving-pinions and present them in position to transmit motion through the pinion G to the pinions J.

We do not claim herein either of the devices or combinations of devices represented in the application of Albert Armitage, filed July 31, 1884, No. 139,357, the present invention being designed as an improvement upon that represented in the Armitage application, and being restricted to devices hereinafter specifically claimed.

Having thus described our invention, what we claim is—

1. In combination with the stationary driving-pinion B and stationary driven pinion D, the rotary carrier provided with secondary pinions of different diameters, each engaging the driving-pinion, the pinion or pinions G, and the movable arm or support H, provided with pinions to communicate motion from pinion G to pinion D, substantially as shown.

2. In combination with the driving-pinion, the secondary pinions, the rotary shell or support therefor, the driven pinion J, and the intermediate pinion, G, of two diameters adapted to receive and impart two speeds, as described.

3. The driving-frame, the rotary shell or support, the secondary pinions carried by the latter, and the pinion G, in combination with the pinion D, and swinging arm provided with pinions I and J, and the slide L, to adjust and lock said arm.

4. In combination with the swinging arm provided with the stud and having the pinions thereon, the slotted slide L, substantially as described, engaging the stud, whereby the pinions may be adjusted and held in and out of gear.

In testimony whereof we hereunto set our hands, this 25th day of July, 1884, in the presence of two attesting witnesses.

HOMER BICKFORD.
ALBERT ARMITAGE.

Witnesses:
ADDISON L. GARDNER,
S. B. MCINTYRE.