J. G. BODEMER.

BACKING OFF BRAKE MECHANISM FOR SELF ACTING MULES.

APPLICATION FILED MAR. 20, 1908.

964,378.

Patented July 12, 1910.

12 SHEETS—SHEET 1.

Fig. 1.

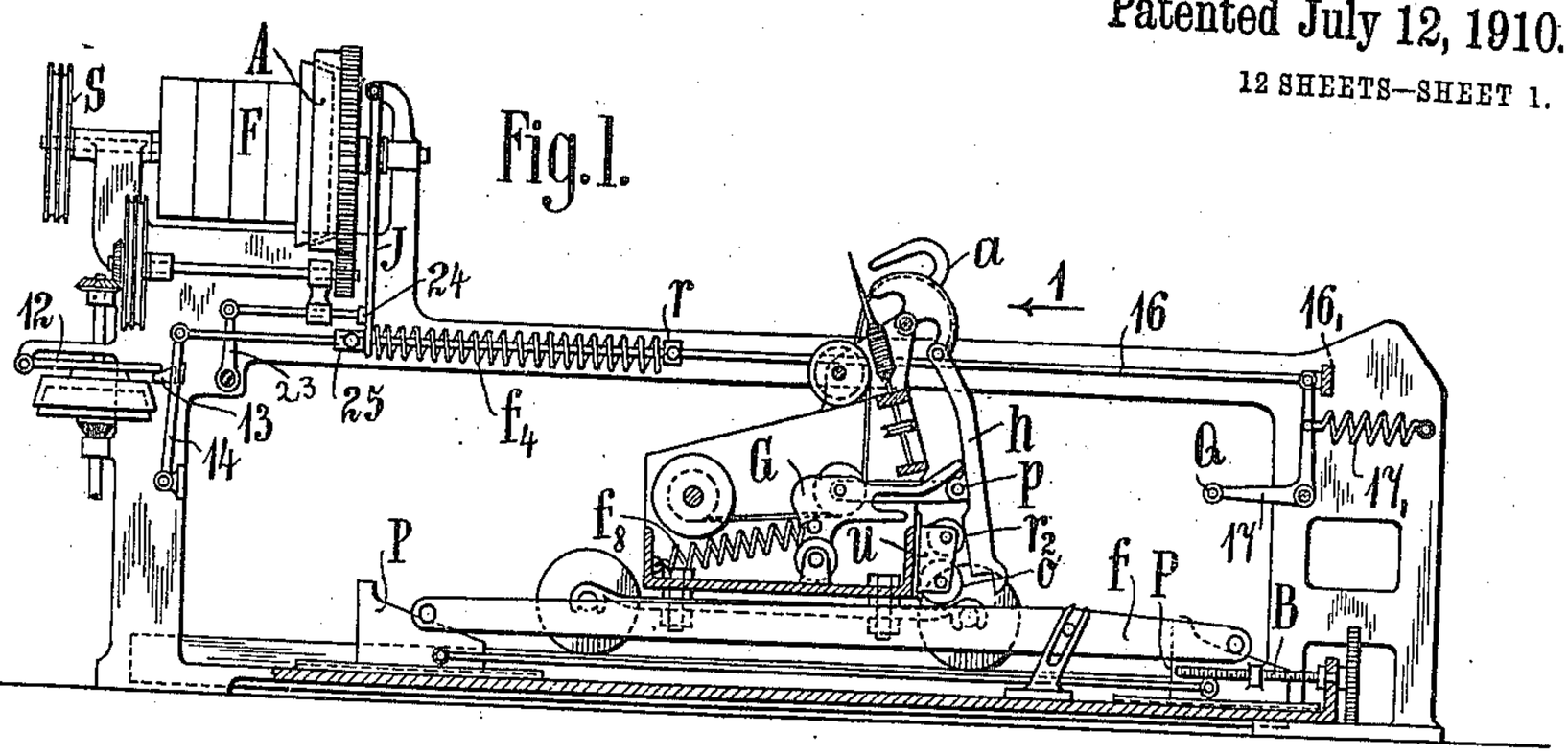


Fig. 2a.

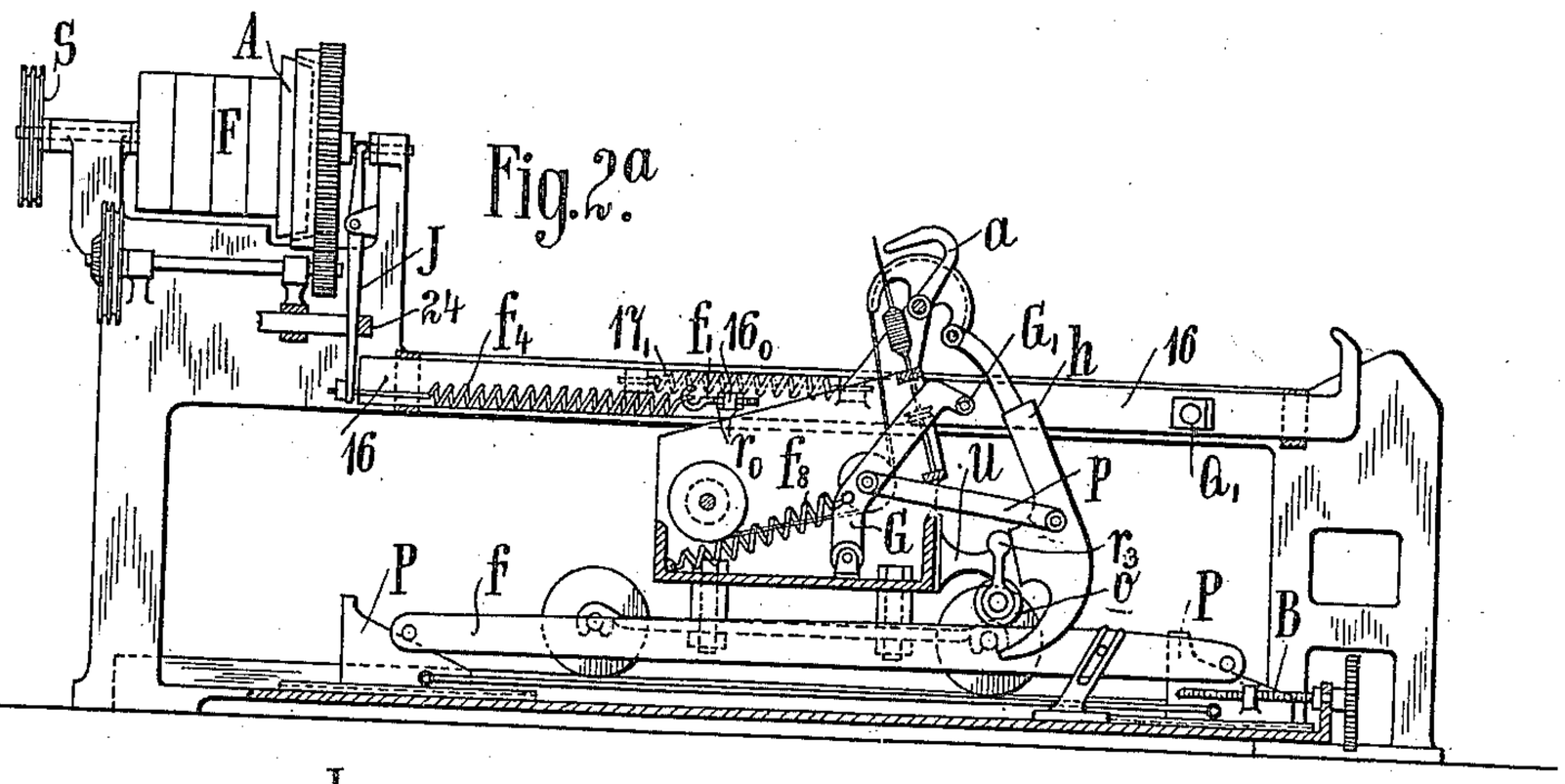


Fig. 2b

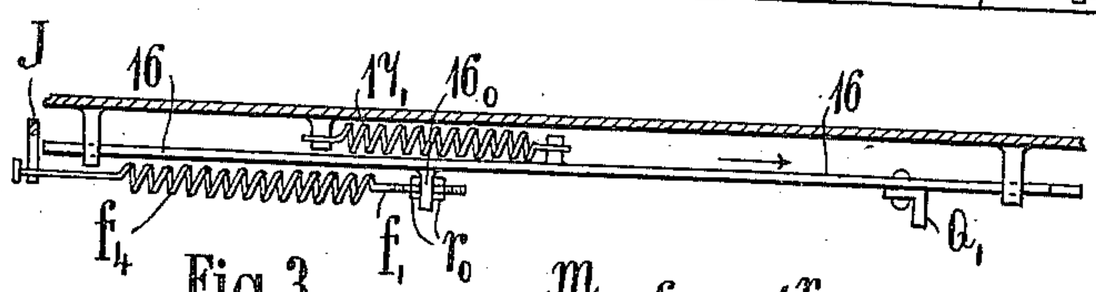


Fig. 3.

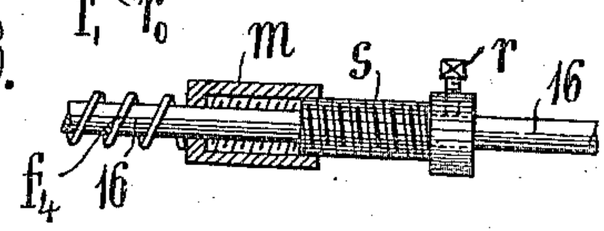


Fig. 3a.

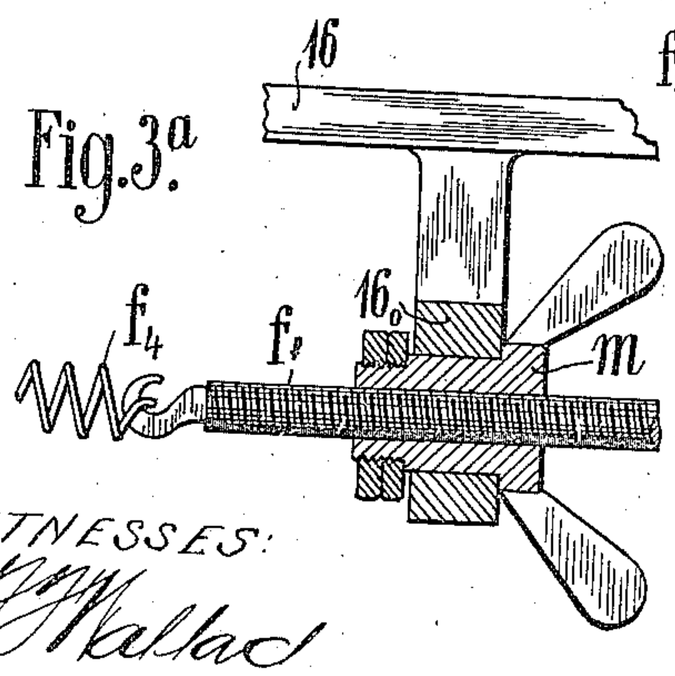


Fig. 4a.

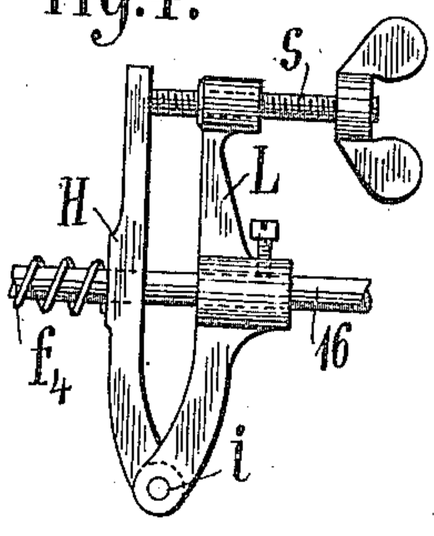
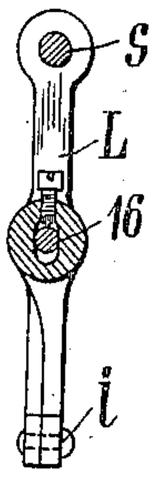


Fig. 4b.



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BACKING OFF BRAKE MECHANISM FOR SELF ACTING MULES.

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964,378.

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12 SHEETS—SHEET 2.

Fig.5a

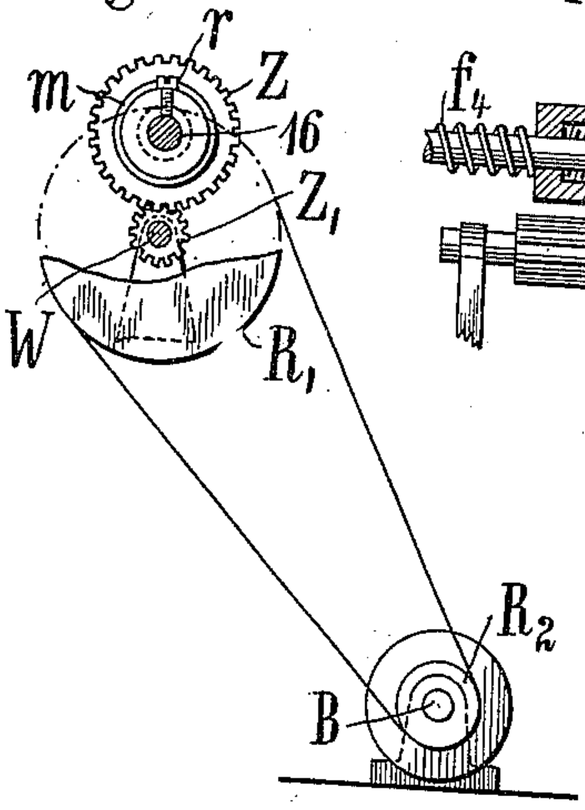


Fig.5b

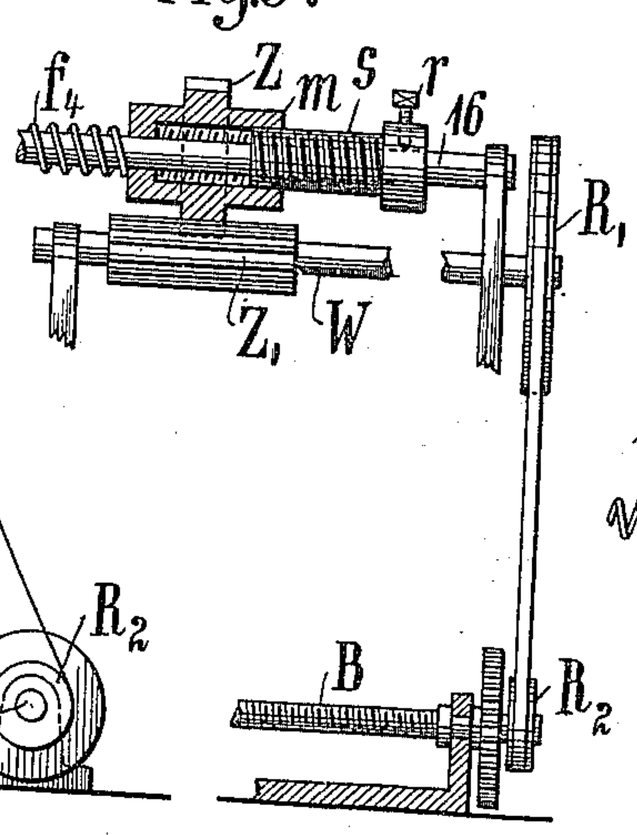


Fig.6c

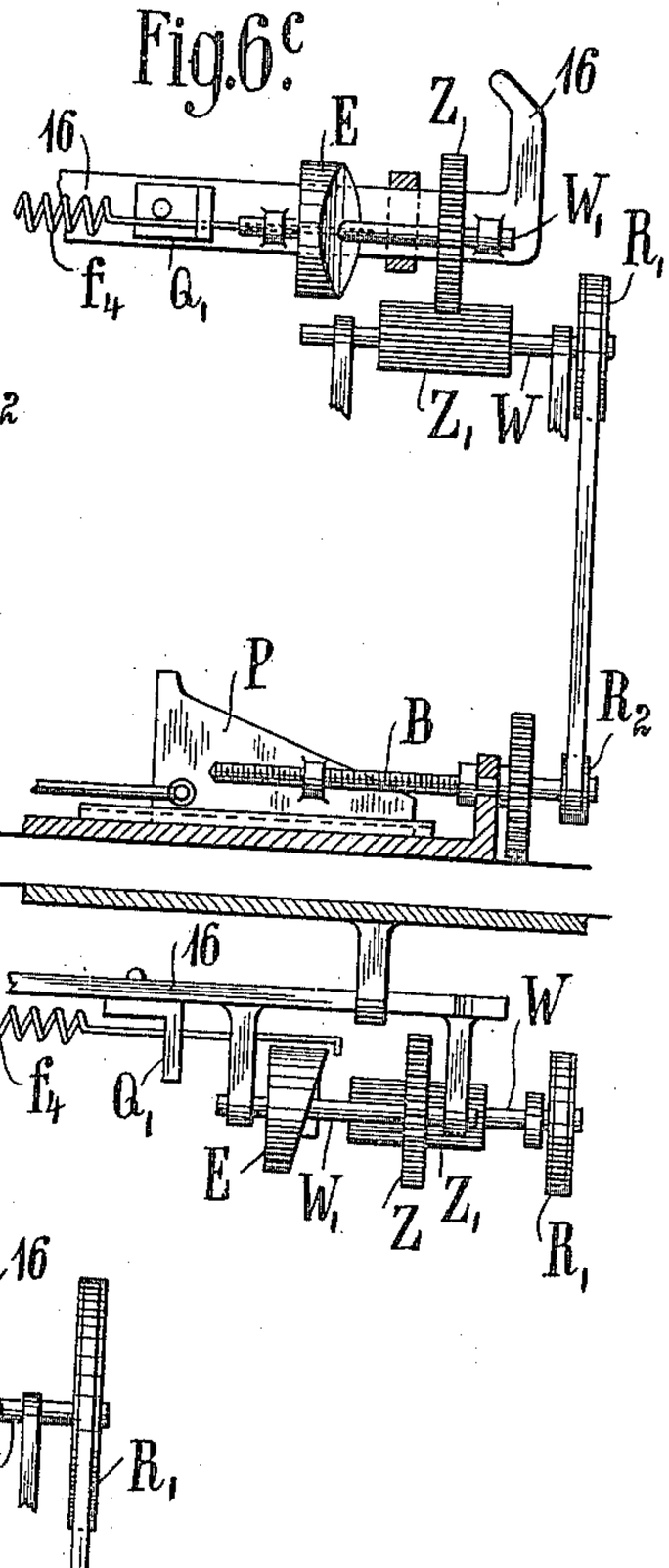


Fig.6d

Fig.6a

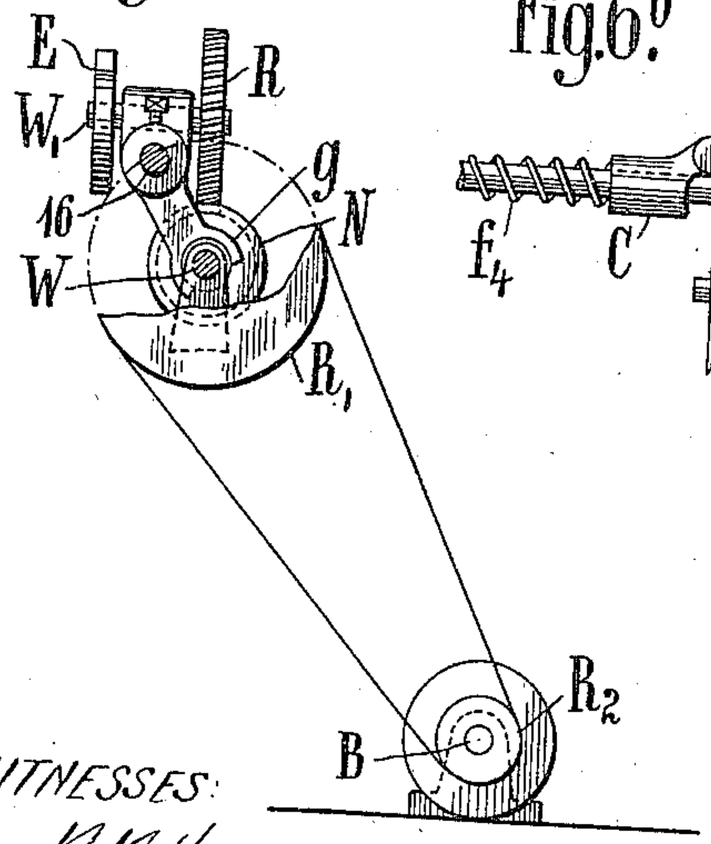
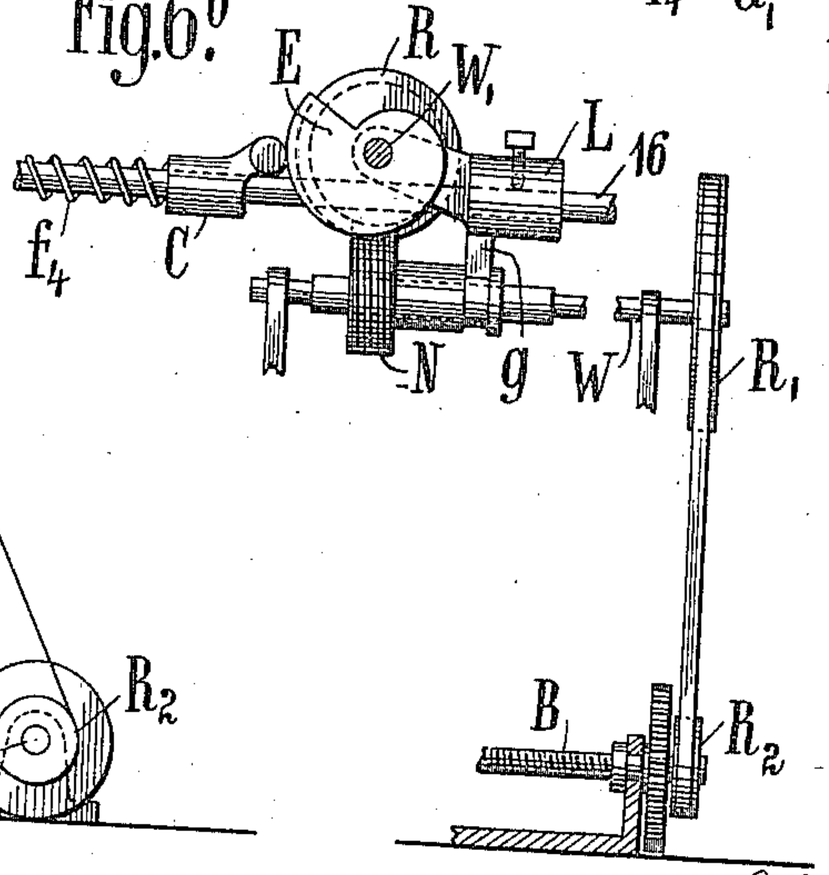


Fig.6b



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12 SHEETS—SHEET 3.

Fig. 7a

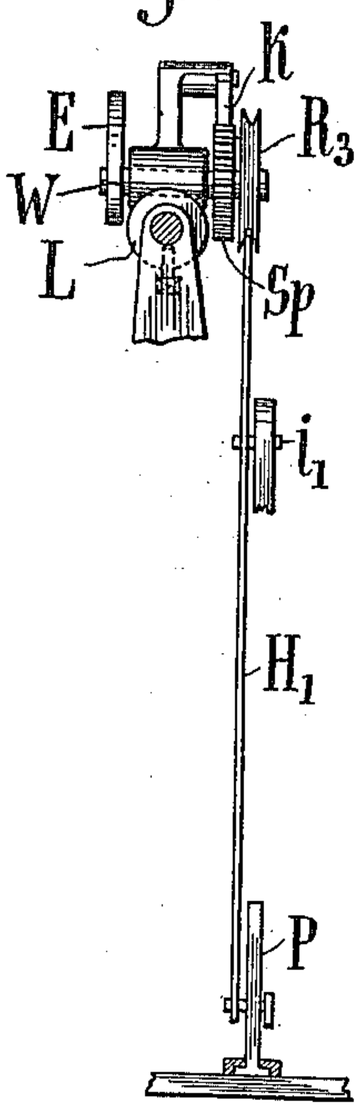


Fig. 7b

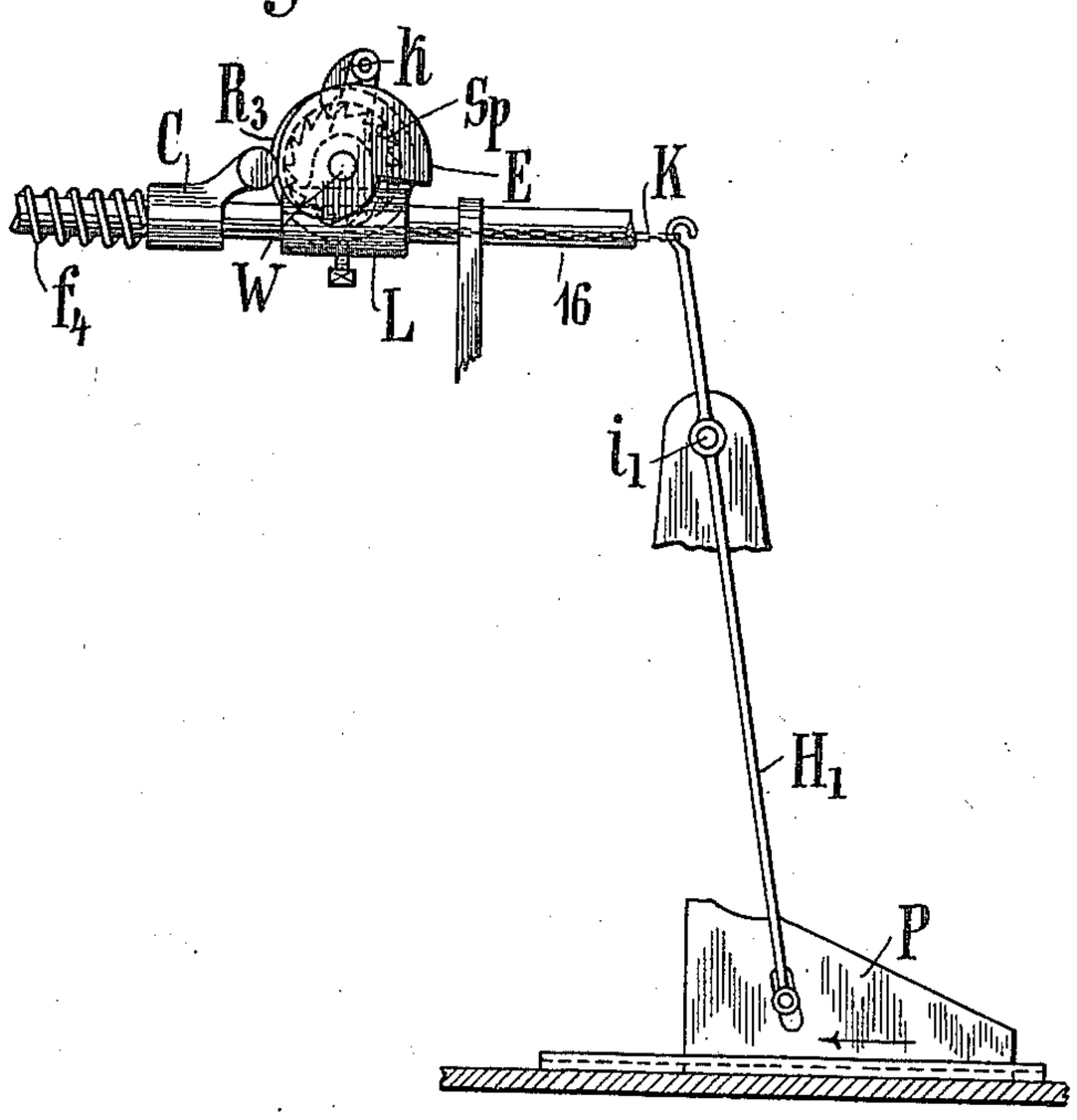


Fig. 8a

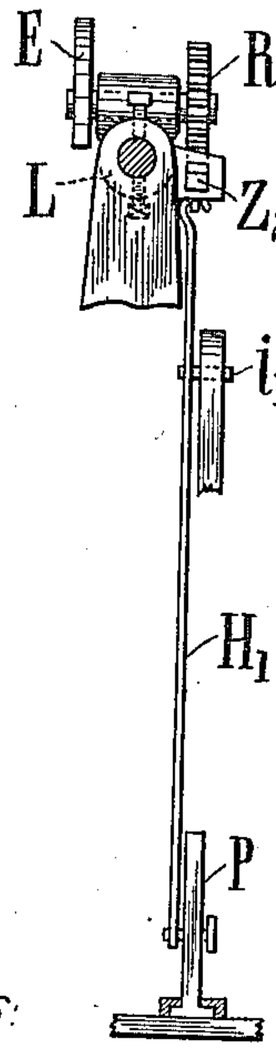
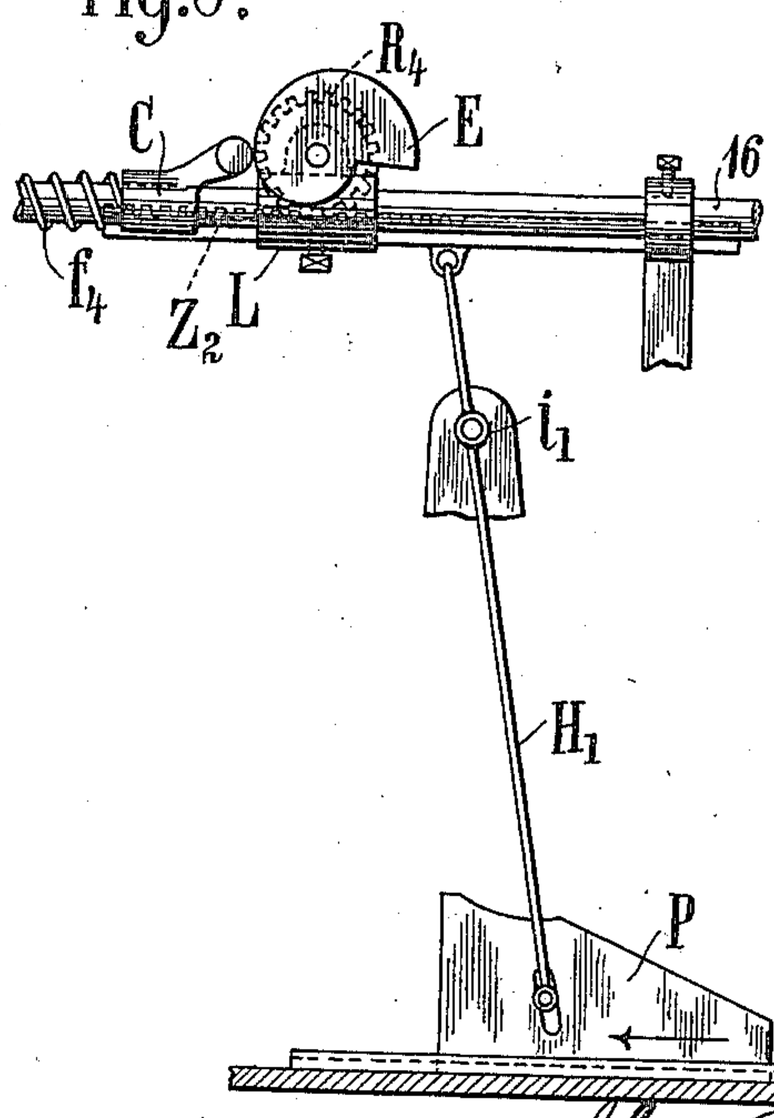


Fig. 8b



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BACKING OFF BRAKE MECHANISM FOR SELF ACTING MULES.

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12 SHEETS—SHEET 4.

Fig. 9a

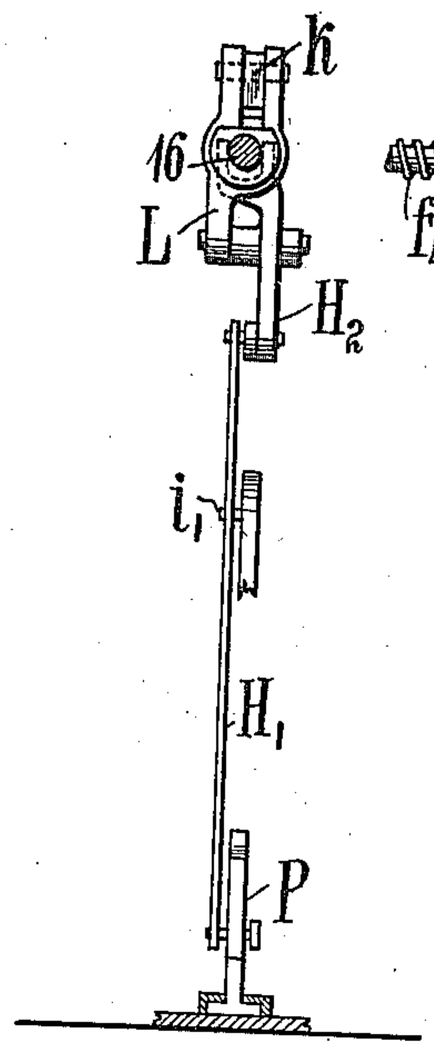


Fig. 9b

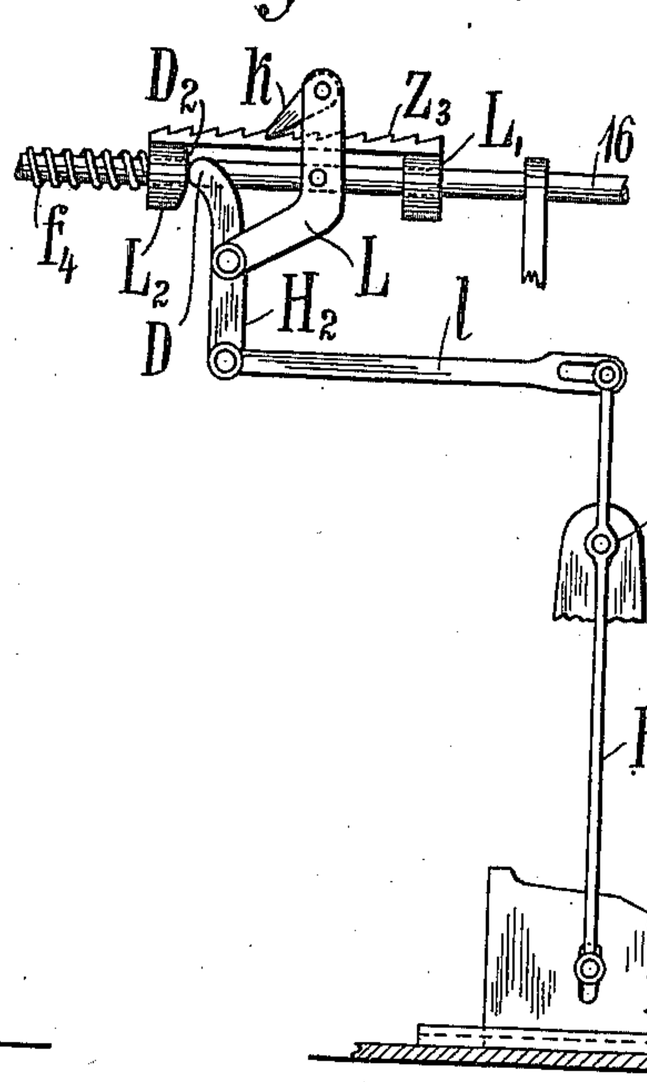


Fig. 10a

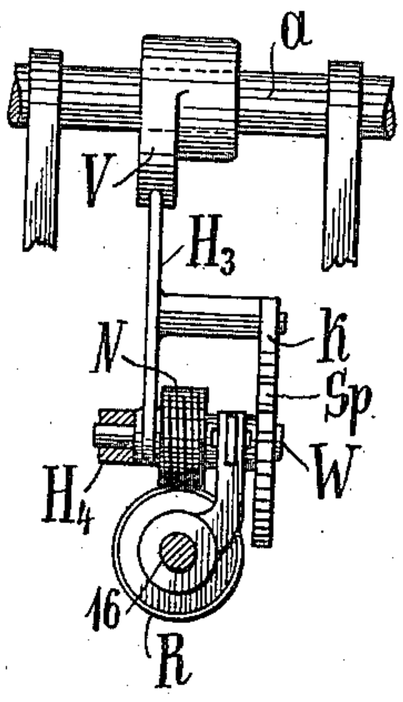
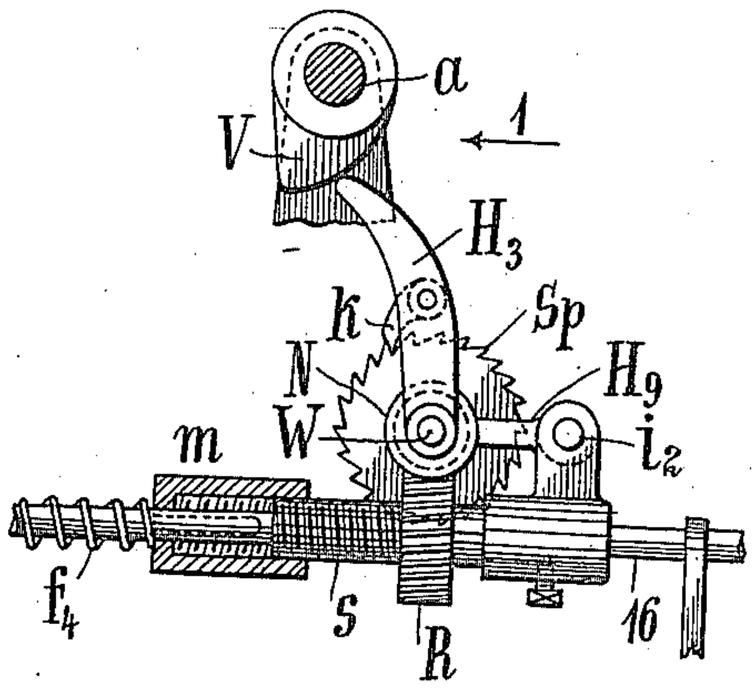


Fig. 10b



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BACKING OFF BRAKE MECHANISM FOR SELF ACTING MULES.

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12 SHEETS—SHEET 5.

Fig.11a.

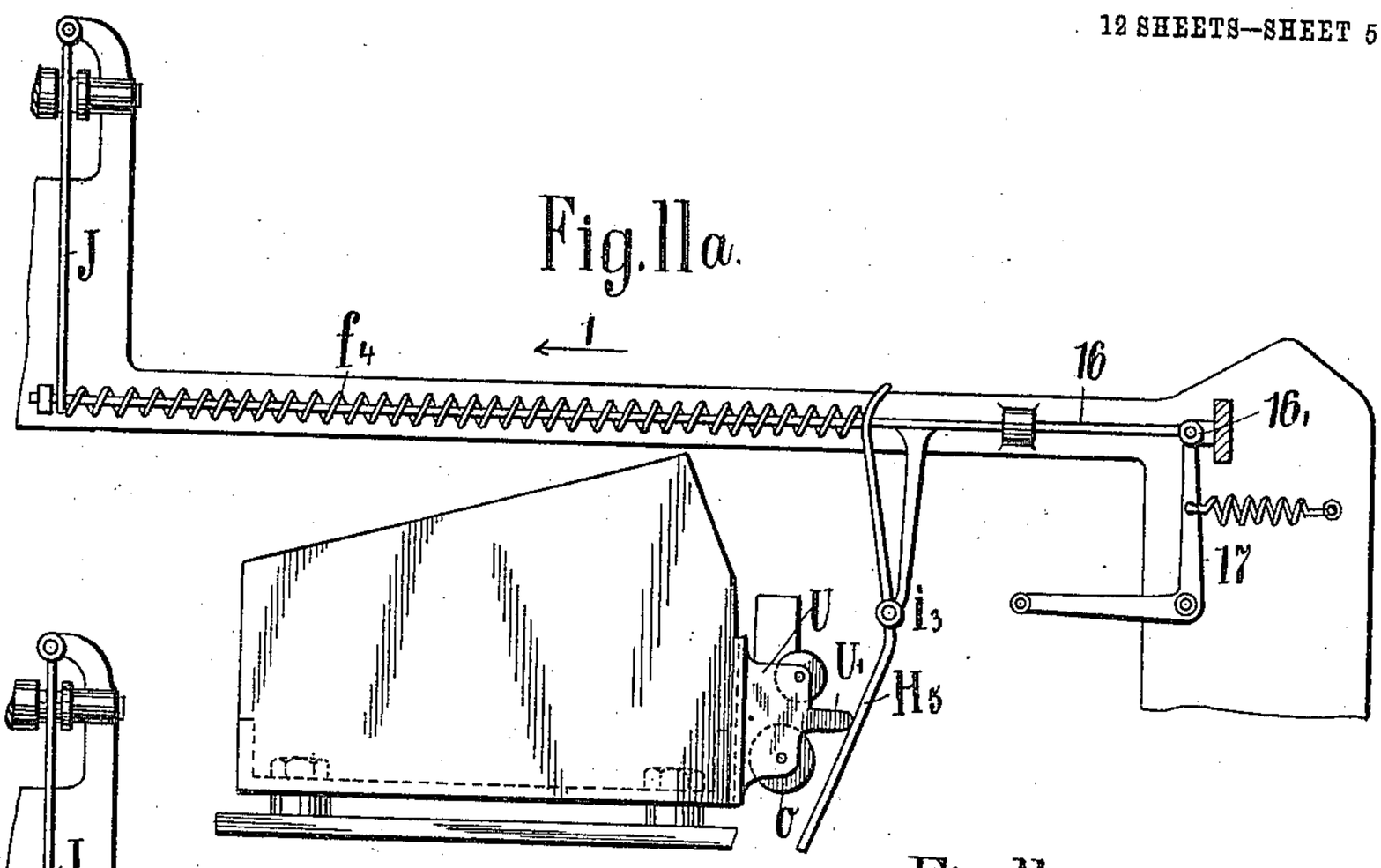


Fig.11b.

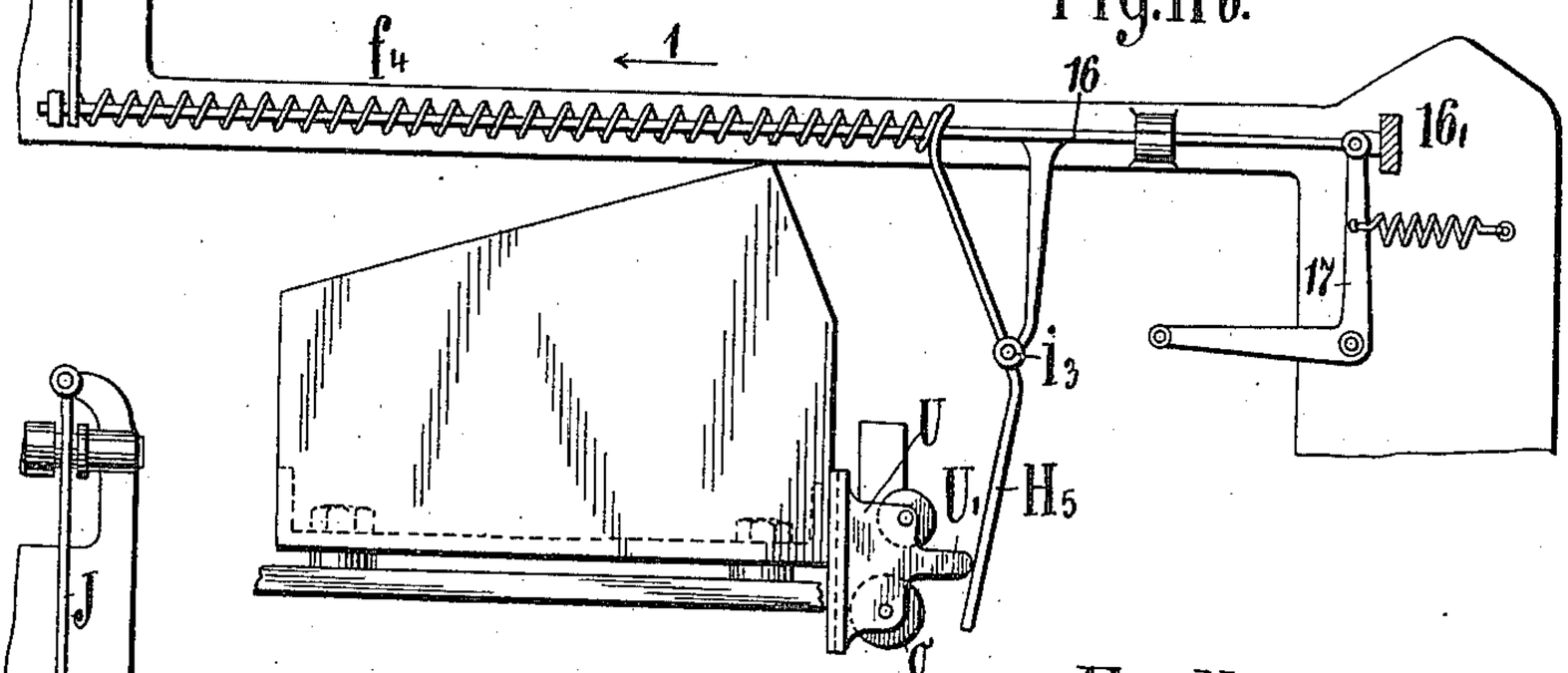
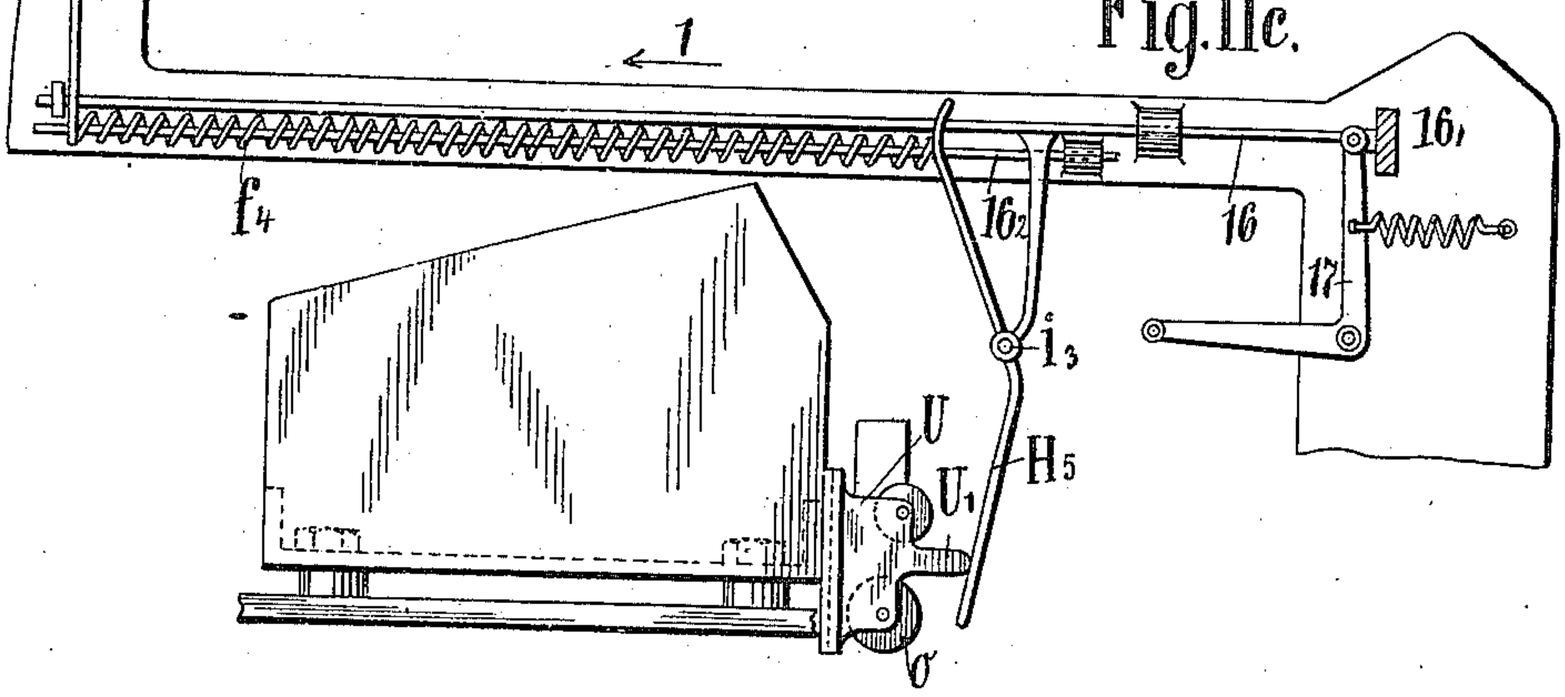


Fig.11c.



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12 SHEETS—SHEET 6.

Fig. 12a.

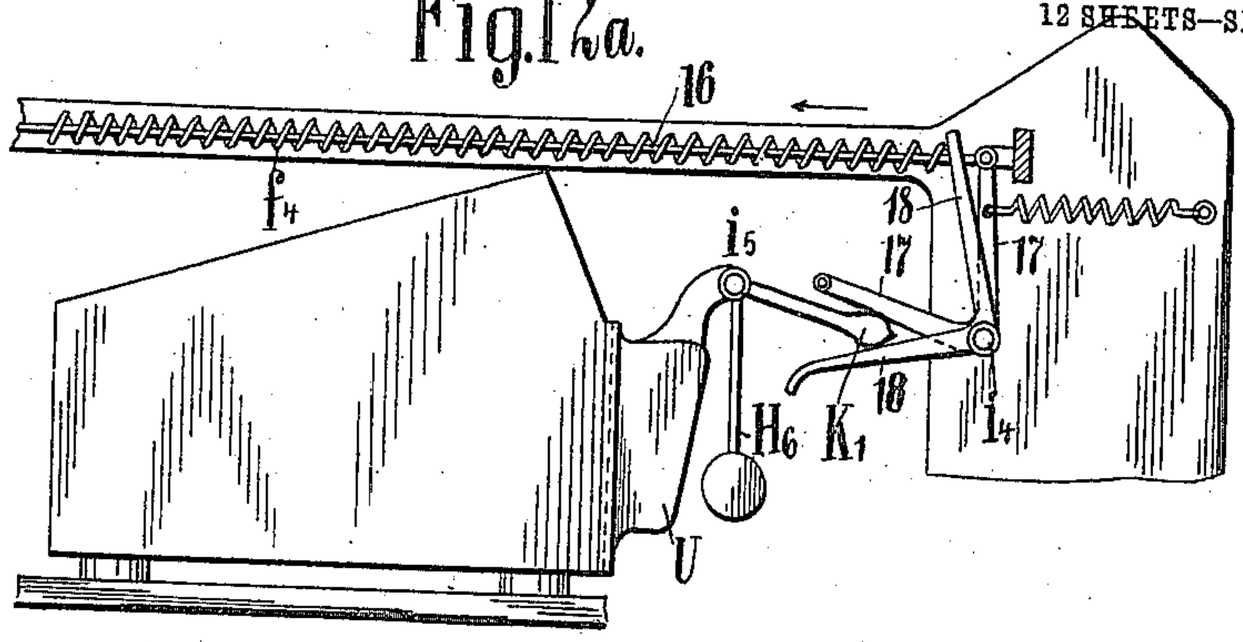


Fig. 12b.

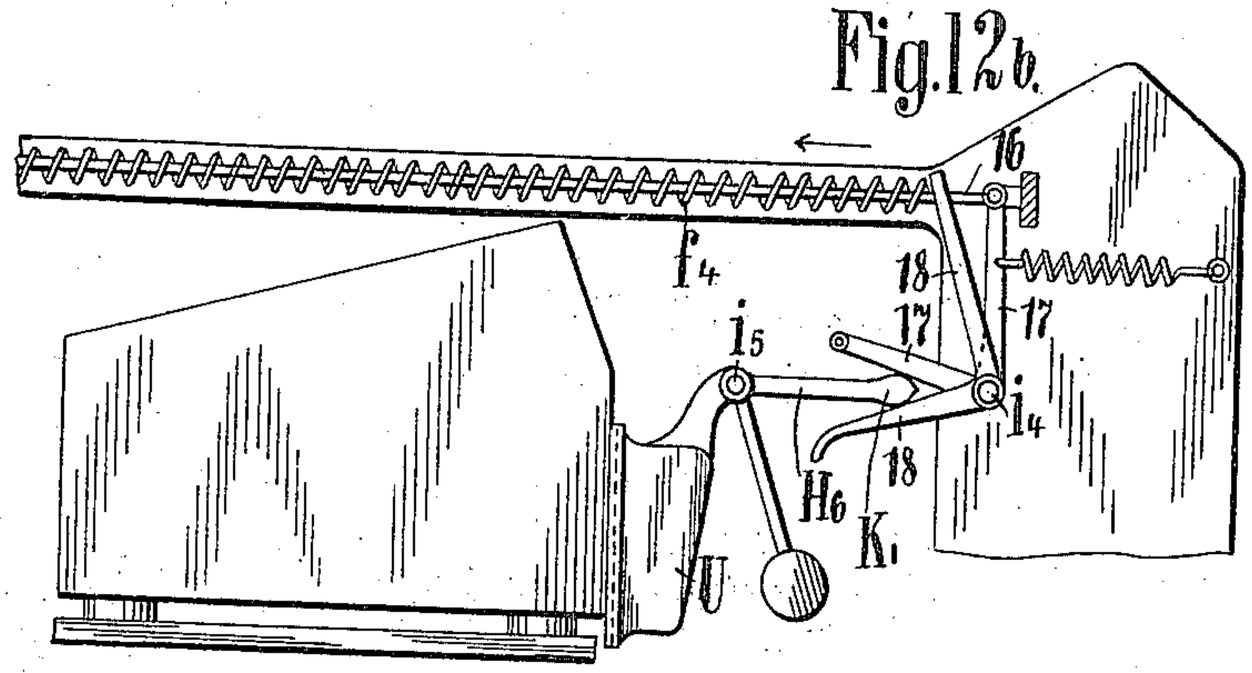


Fig. 13a.

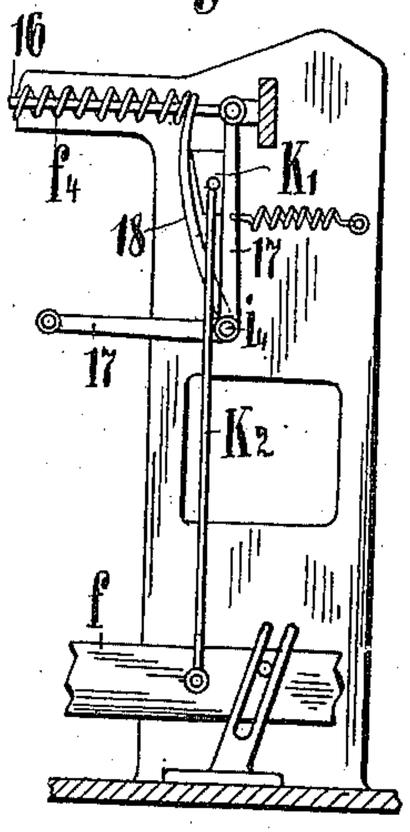


Fig. 13b.

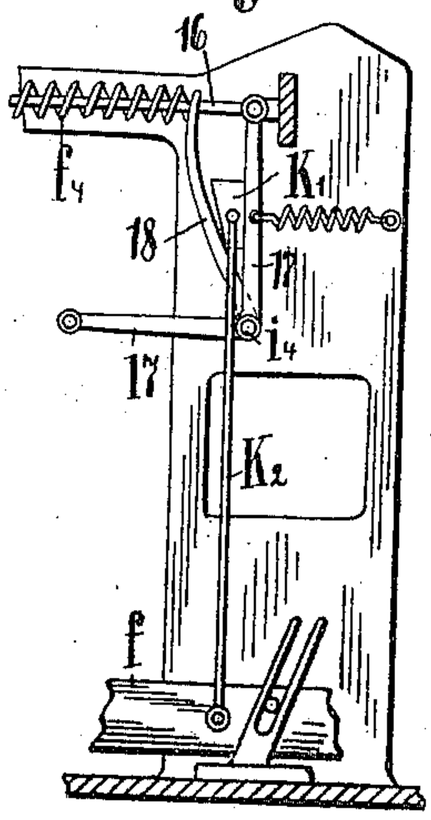
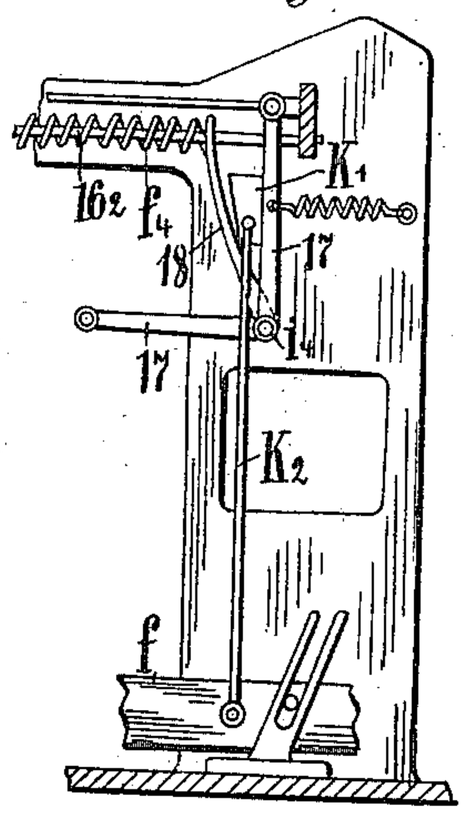


Fig. 13c



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BACKING OFF BRAKE MECHANISM FOR SELF ACTING MULES.

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12 SHEETS—SHEET 7.

Fig. 14a.

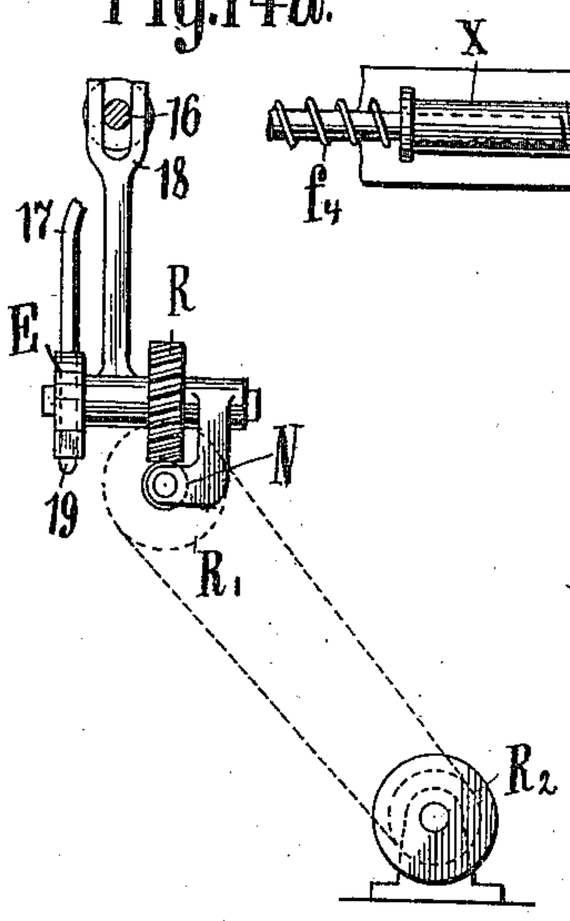
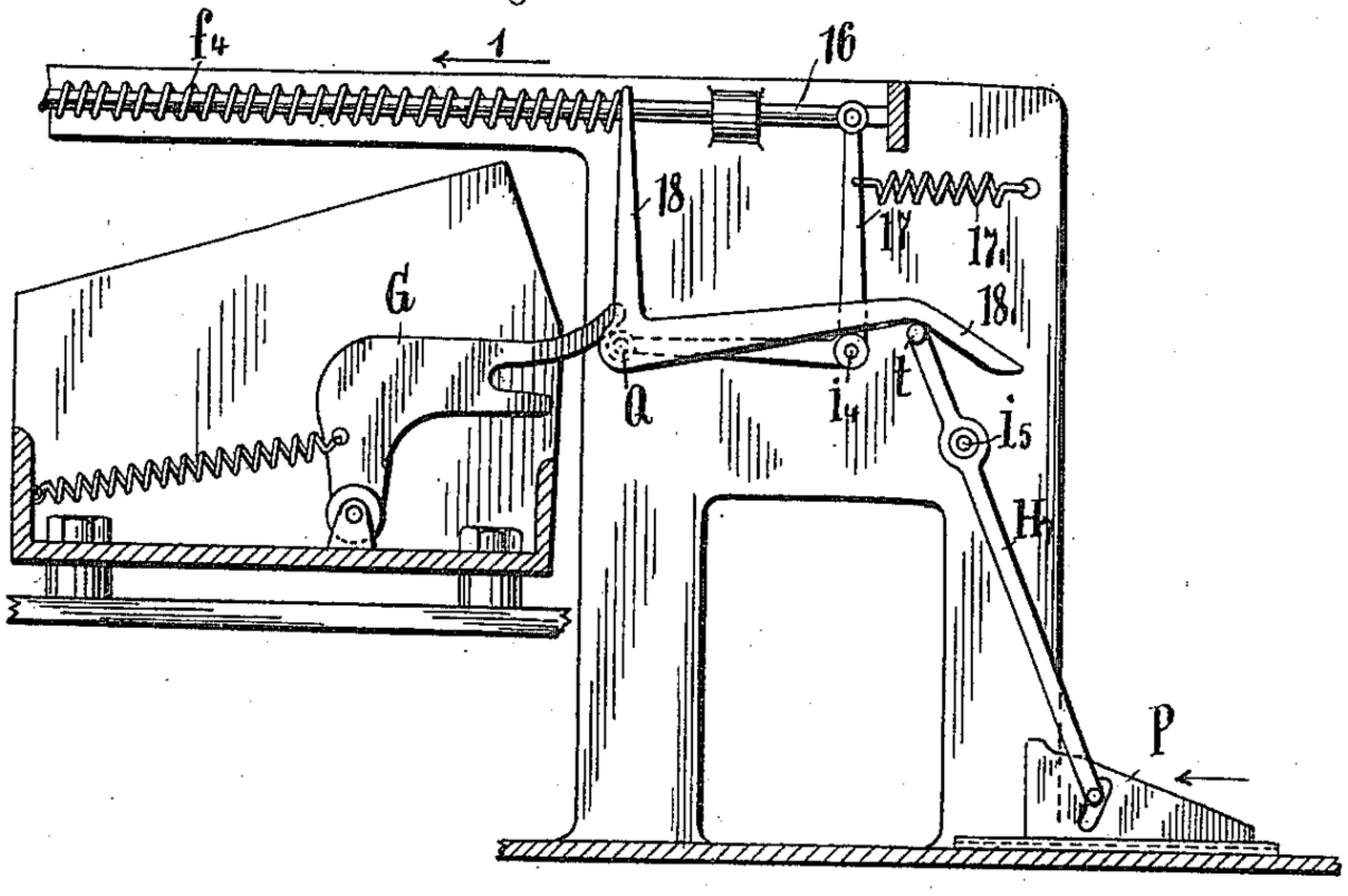


Fig. 14b.

Fig. 15.



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BACKING OFF BRAKE MECHANISM FOR SELF ACTING MULES.

APPLICATION FILED MAR. 20, 1908.

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12 SHEETS—SHEET 8.

Fig. 16.

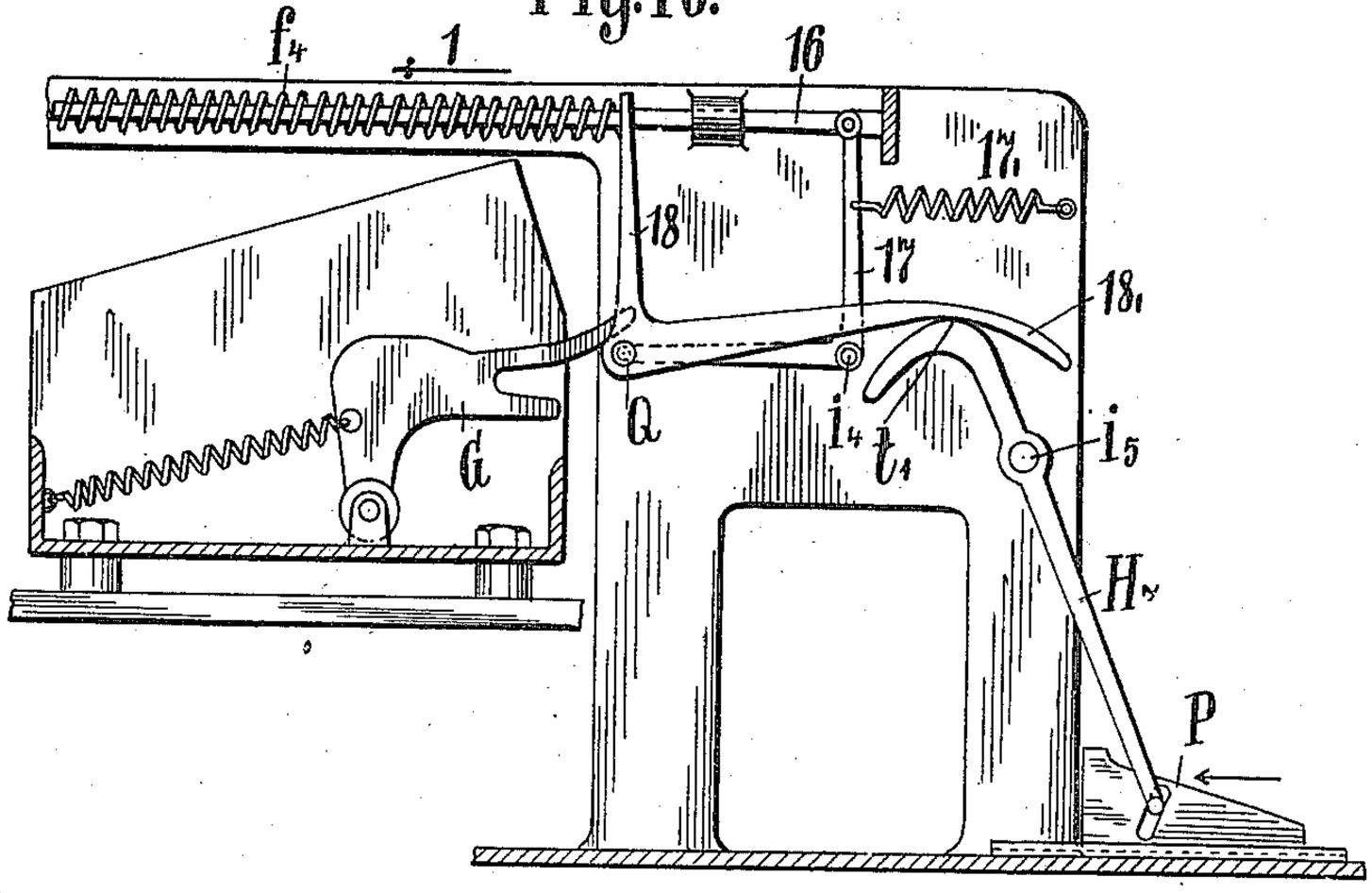
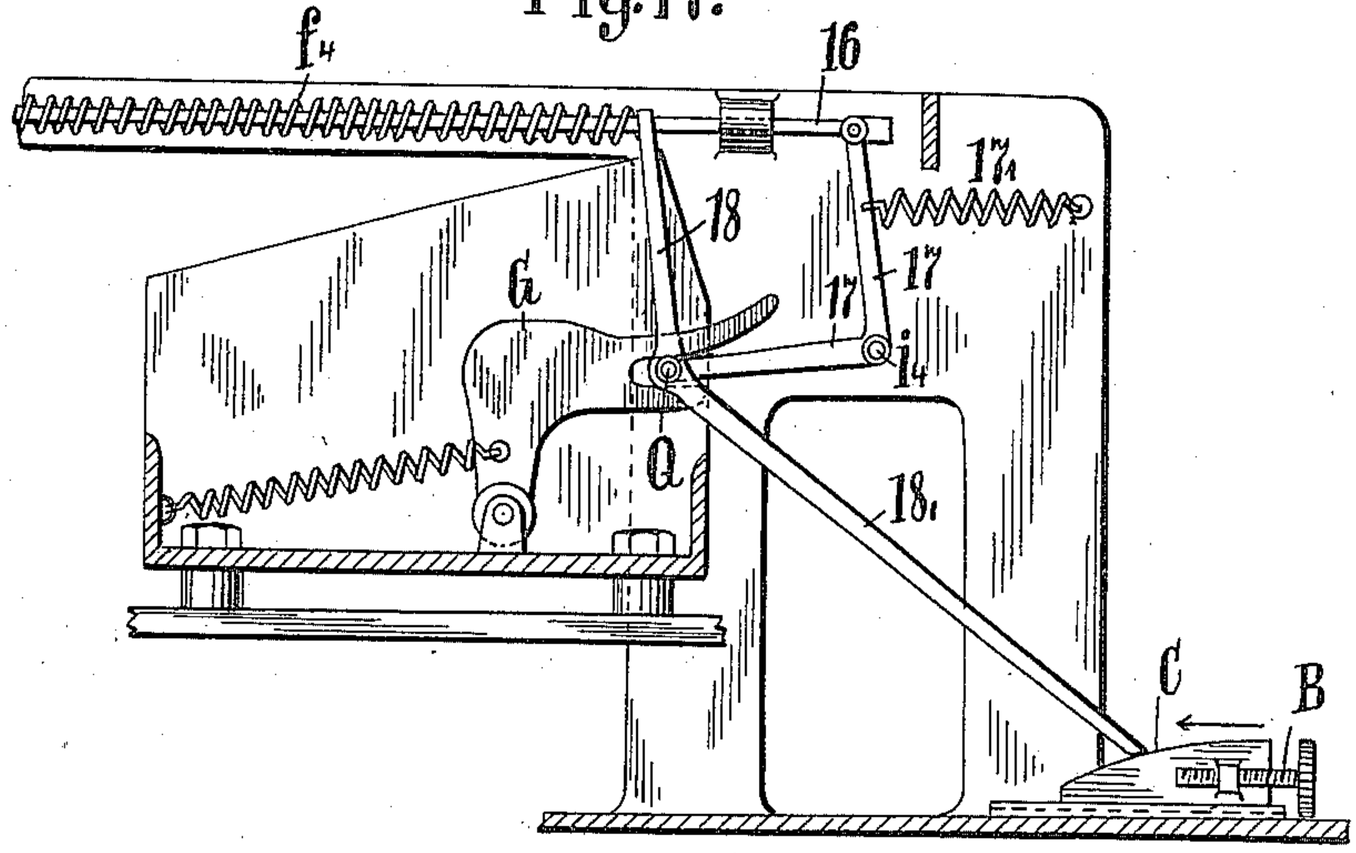


Fig. 17.



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BACKING OFF BRAKE MECHANISM FOR SELF ACTING MULES.

APPLICATION FILED MAR. 20, 1908.

964,378.

Patented July 12, 1910.

12 SHEETS—SHEET 9.

Fig.18.

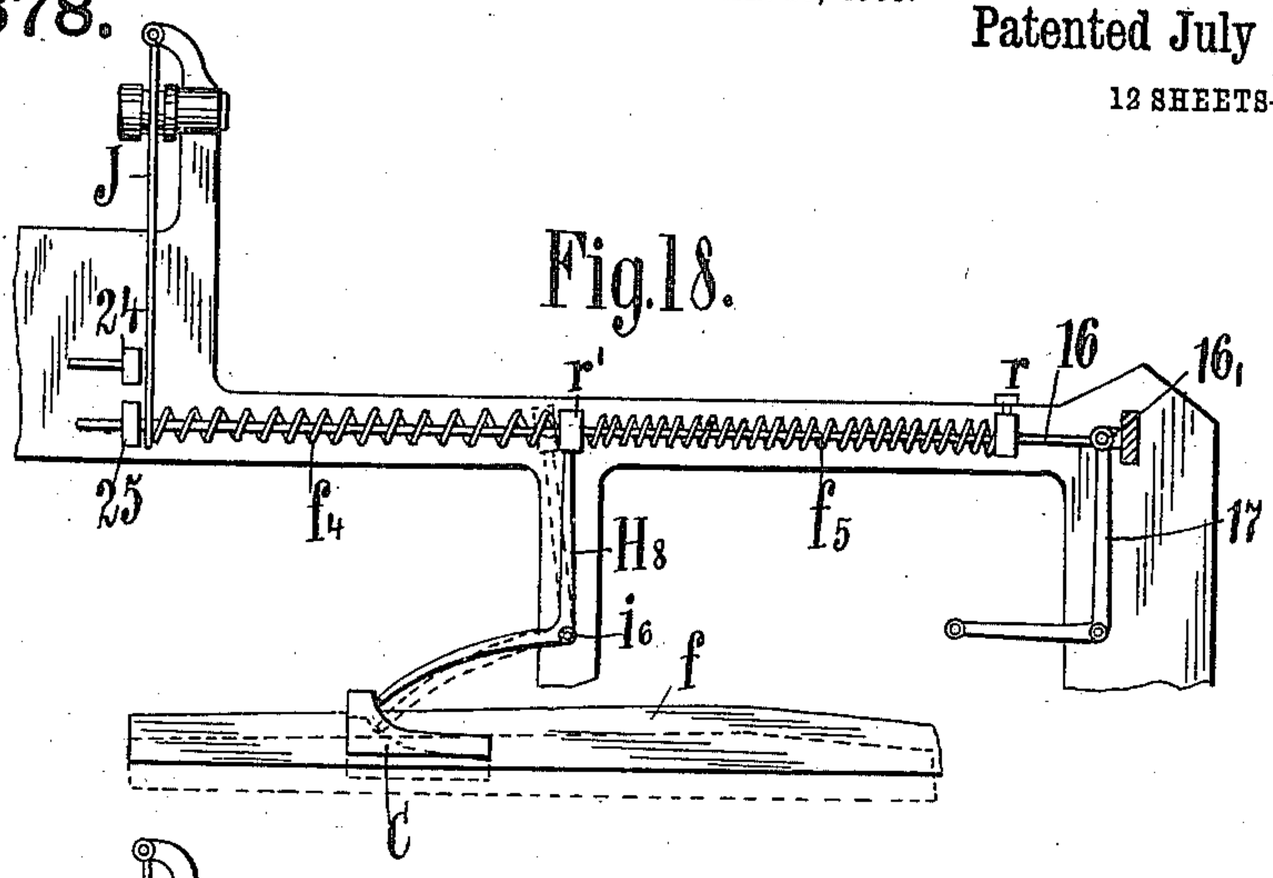


Fig.18a

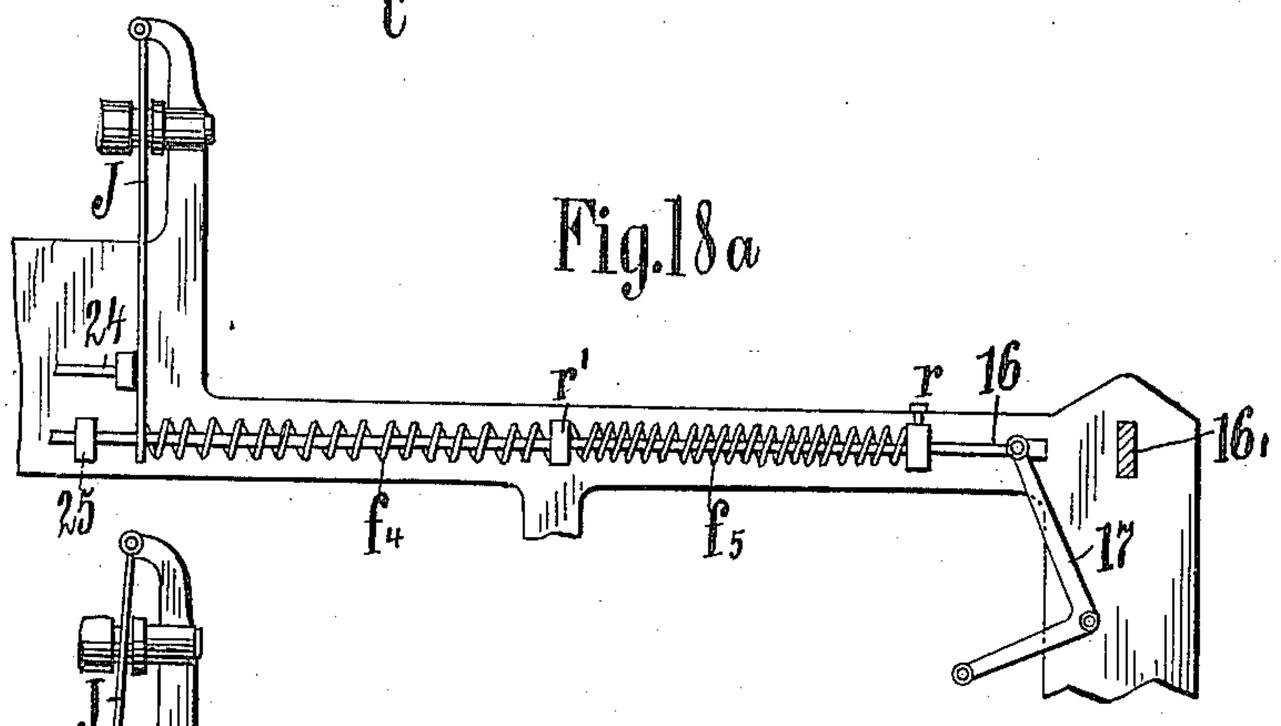


Fig.18b

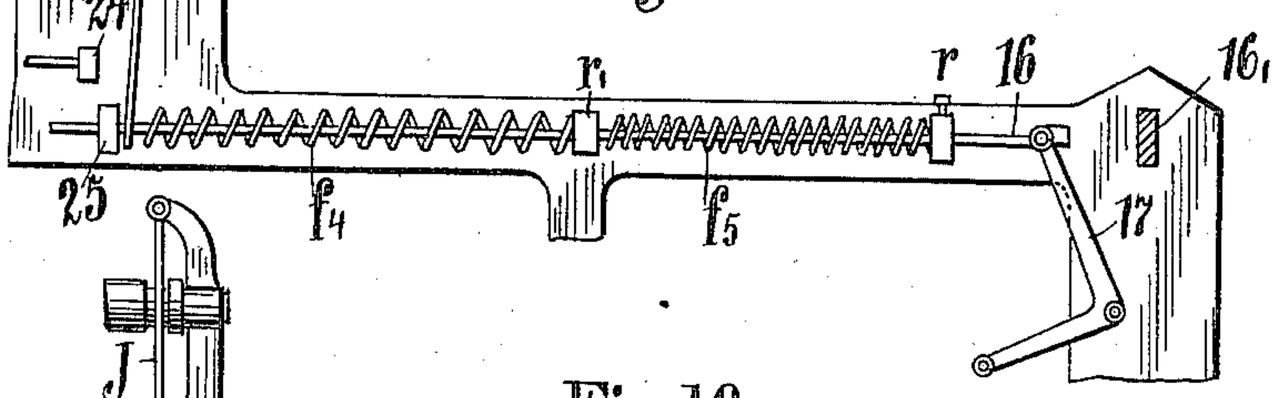
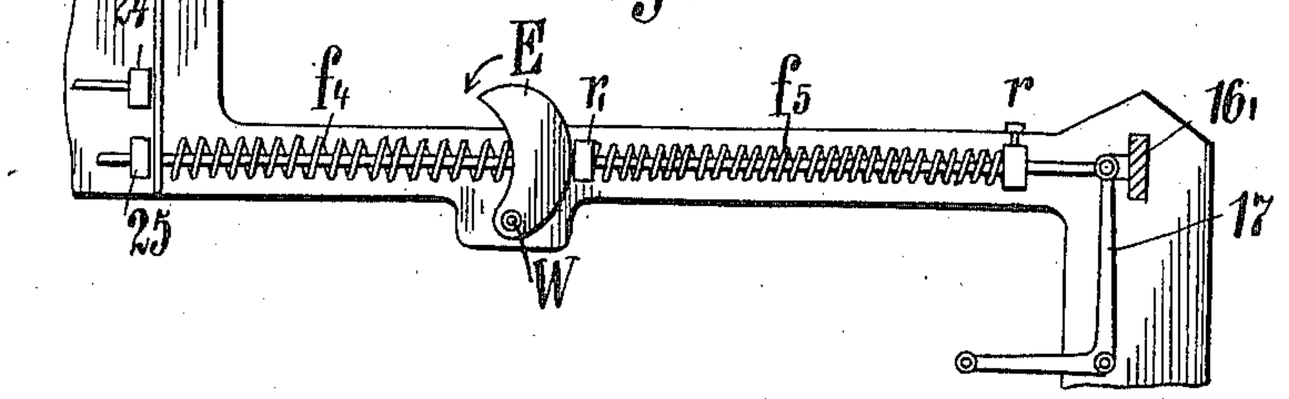


Fig.19.



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BACKING OFF BRAKE MECHANISM FOR SELF ACTING MULES.

APPLICATION FILED MAR. 20, 1908.

964,378.

Patented July 12, 1910.

12 SHEETS—SHEET 10.

Fig. 20a.

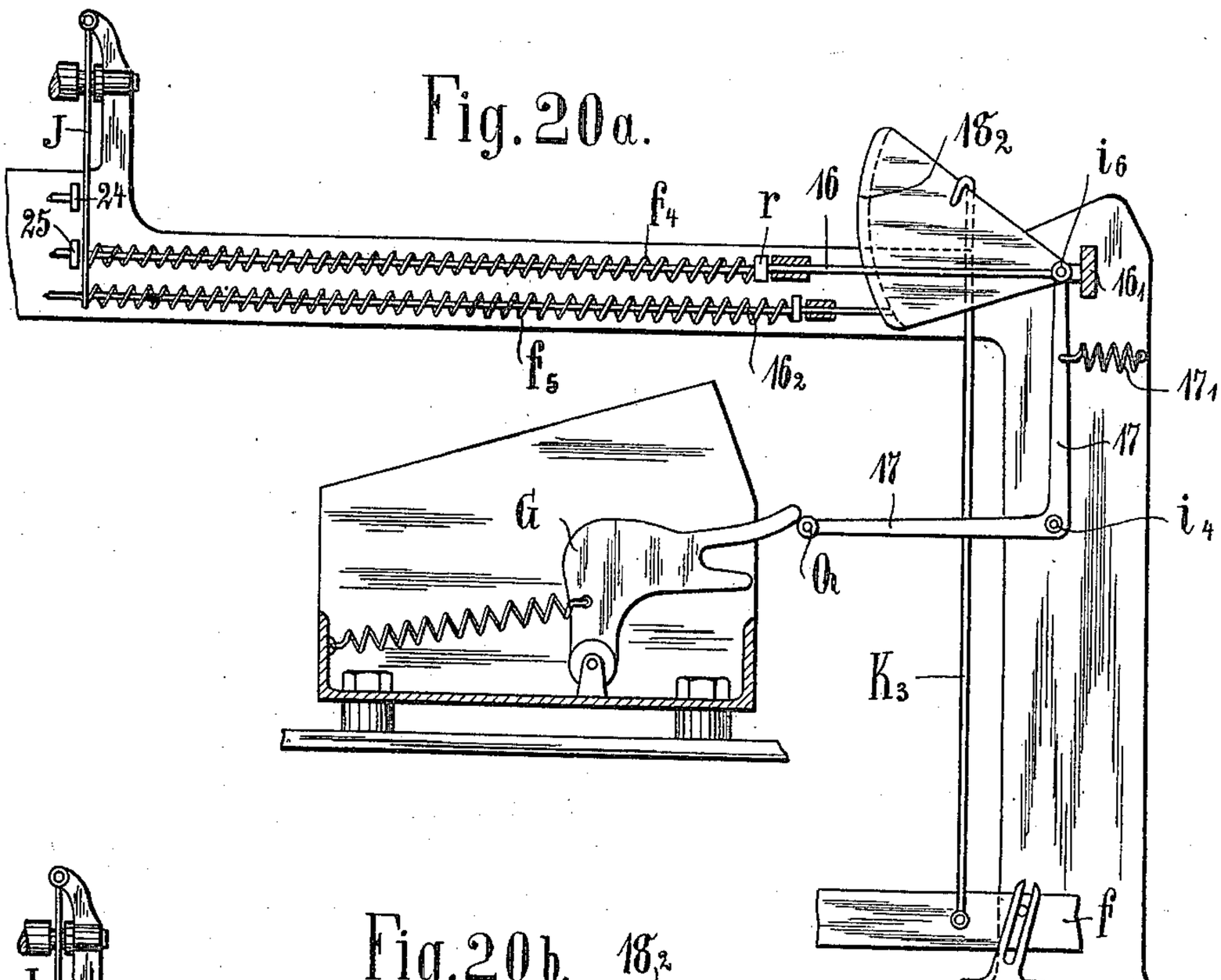
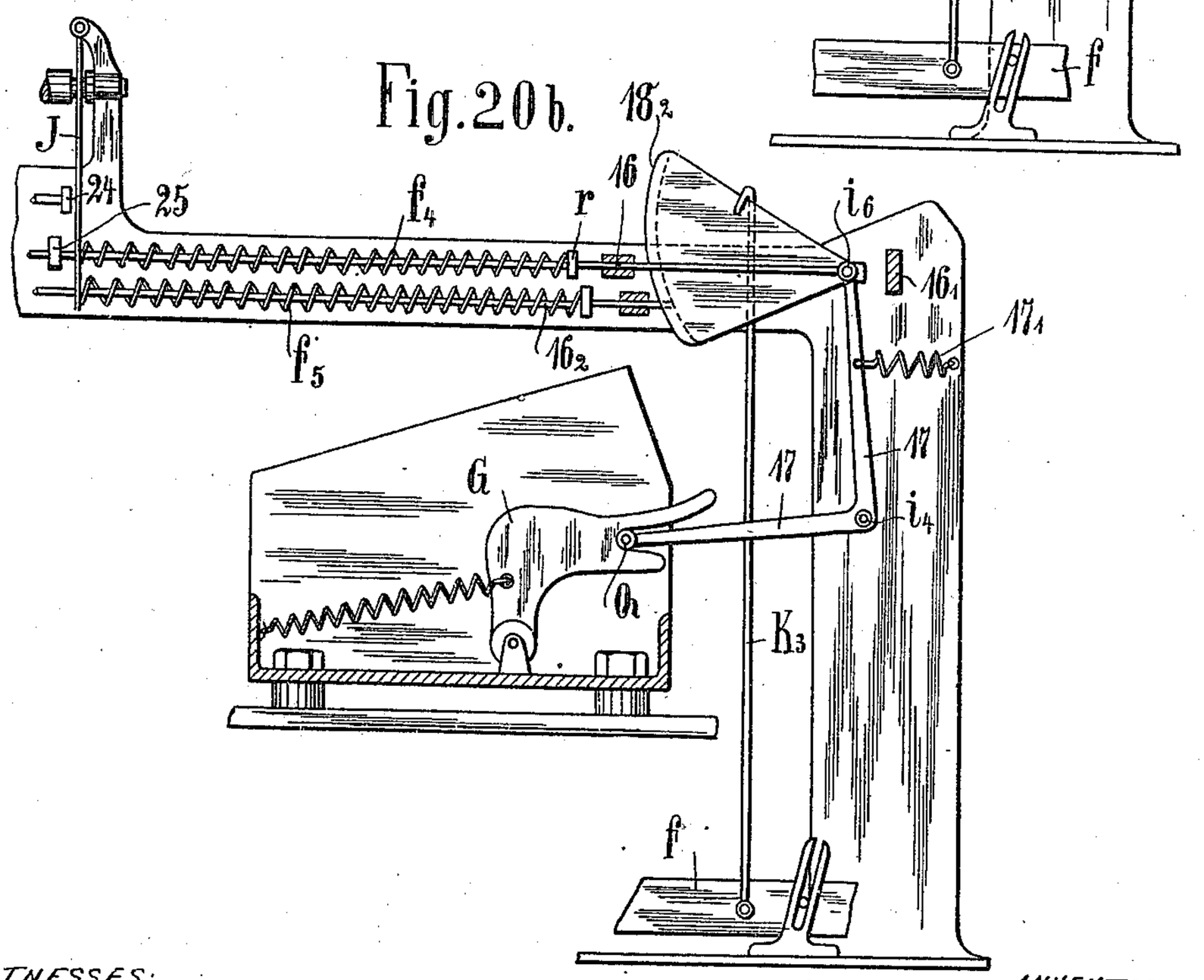


Fig. 20b.



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BACKING OFF BRAKE MECHANISM FOR SELF ACTING MULES.

APPLICATION FILED MAR. 20, 1908.

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Patented July 12, 1910.

12 SHEETS—SHEET 11.

Fig. 21a.

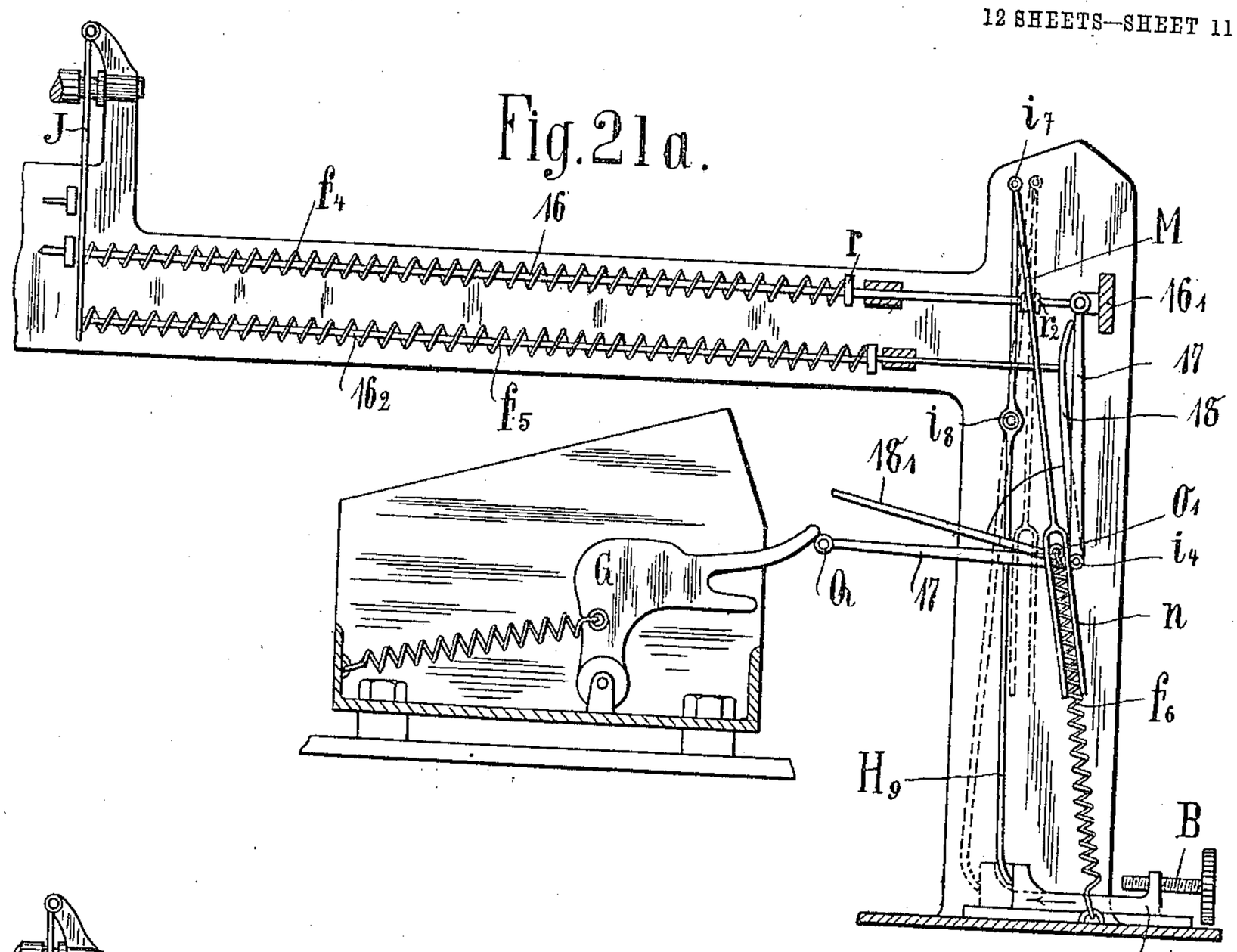
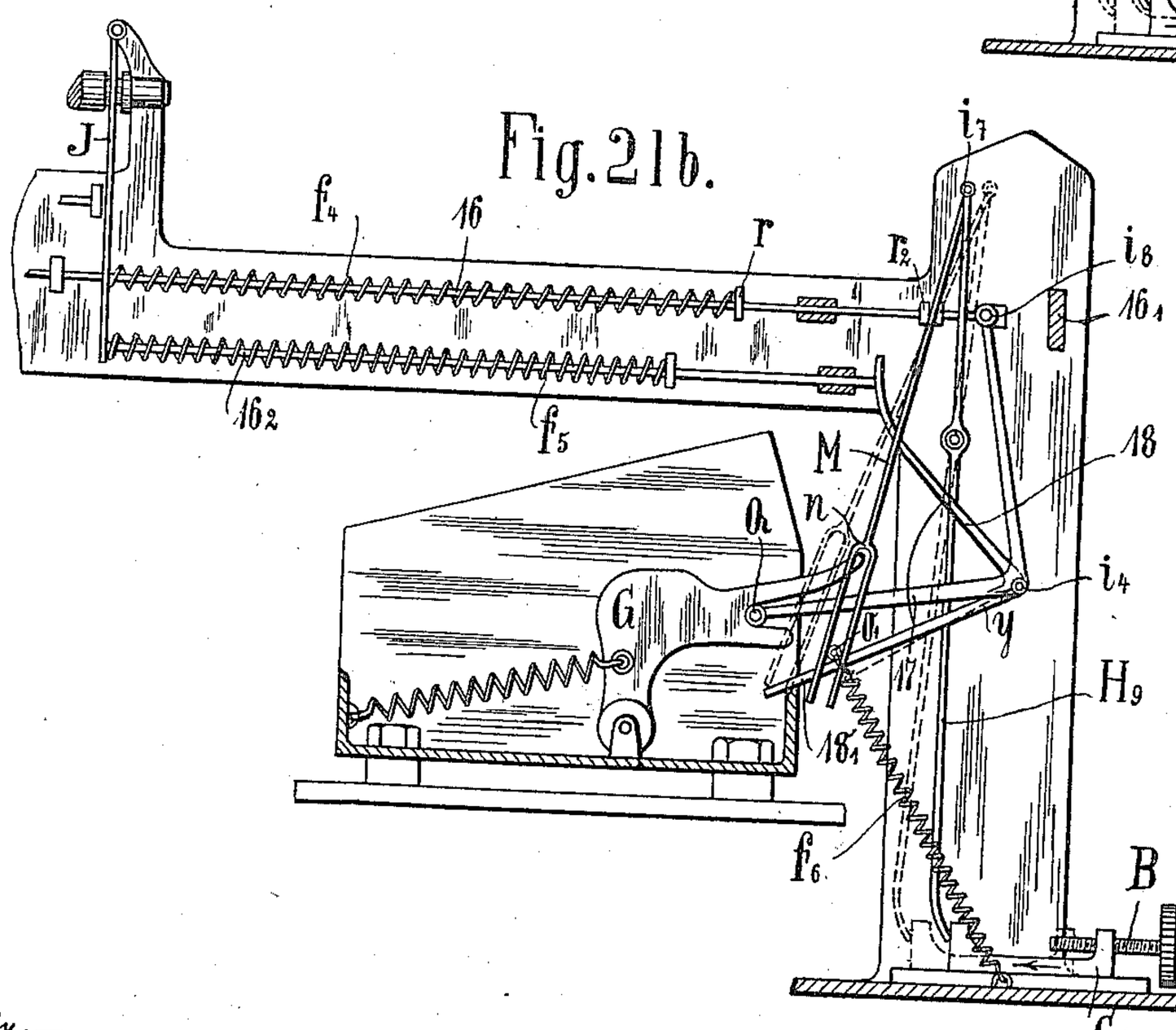


Fig. 21b.



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BACKING OFF BRAKE MECHANISM FOR SELF ACTING MULES.

APPLICATION FILED MAR. 20, 1908.

964,378.

Patented July 12, 1910.

12 SHEETS—SHEET 12.

Fig. 22 a.

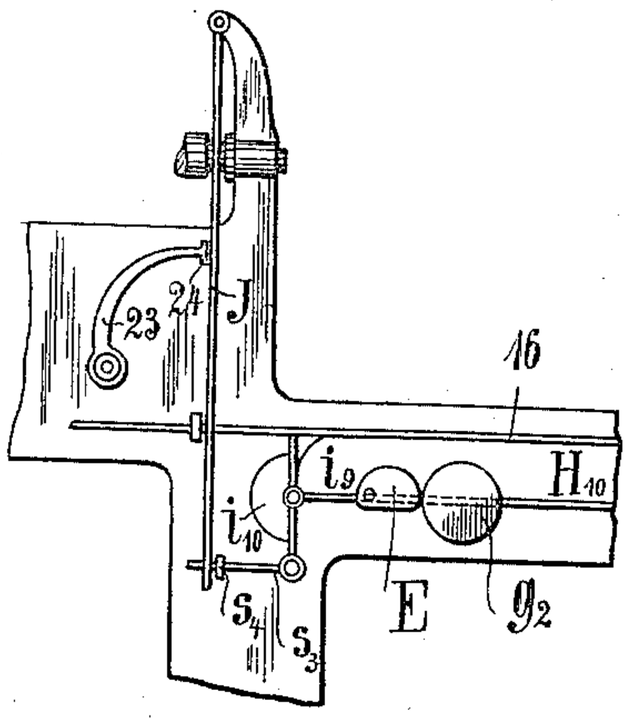


Fig. 22 b.

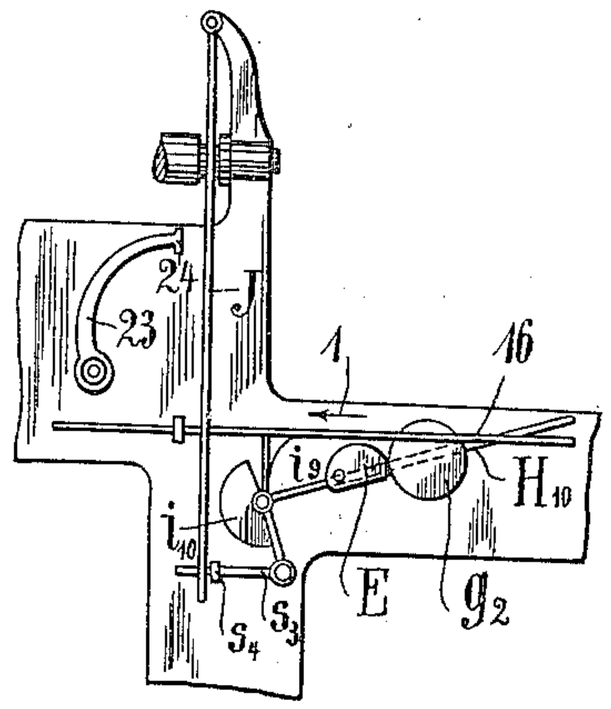
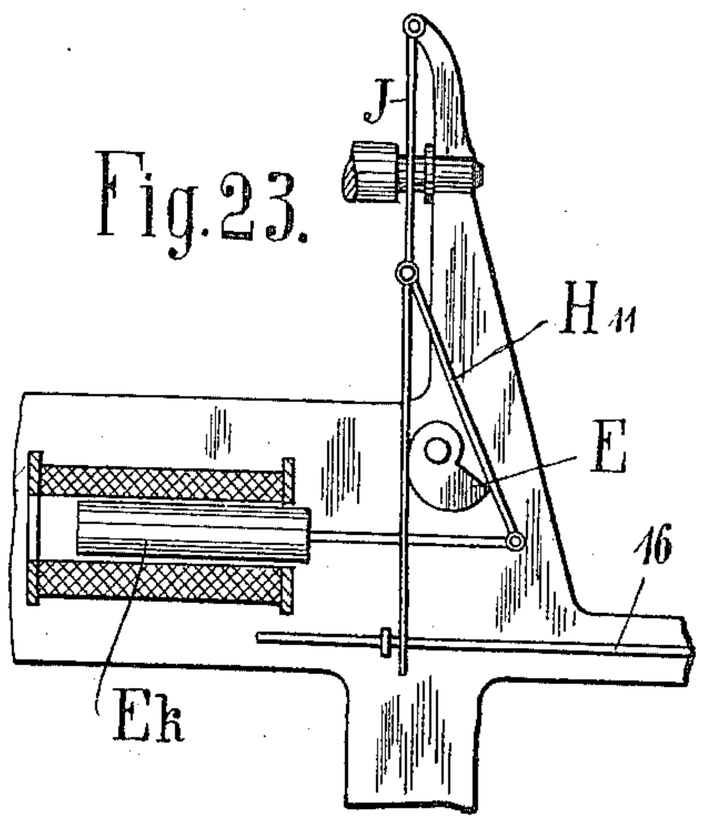


Fig. 23.



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UNITED STATES PATENT OFFICE.

JOHANN GEORG BODEMER, OF ZSCHOPAU, GERMANY.

BACKING-OFF BRAKE MECHANISM FOR SELF-ACTING MULES.

964,378. Specification of Letters Patent. Patented July 12, 1910.

Application filed March 20, 1908. Serial No. 422,297.

To all whom it may concern:

Be it known that I, JOHANN GEORG BODEMER, a subject of the King of Saxony, residing at 211 Georgenstrasse, Zschopau, Saxony, Germany, have invented certain new and useful Improvements in Backing-Off Brake Mechanism for Self-Acting Mules, of which the following is a specification.

In self-acting mules the spindles are turned, toward the end of the spinning, for a short time in the backward direction, for the purpose of backing-off the threads which were wound on the upper end of the cop and the spindle during the spinning. For this purpose the main driving shaft with all of the parts driven thereby, and especially the spindles, must not only be stopped, but also be turned in the backward direction. As the mass of the yarn wound upon the spindles increases progressively, there is required for the full spindles a greater length of time before they come to rest and commence to turn in the opposite direction, than is required with spindles containing a small amount of yarn.

The present invention aims to avoid this loss of time, and thus to shorten the time necessary for the obtaining of a determined quantity of yarn with the machines of former types, and also to obtain certain other advantages. For this purpose the present invention provides that the pressure with which the backing-off brake engages the main shaft and reverses its movement, shall increase gradually, as the making of the cop progresses, the increase being accomplished either by hand or by automatic mechanism as hereinafter referred to in detail.

In self-acting mules of known types, the pressure for the backing-off brake is generally obtained by means of a spring; but in consequence of the peculiar arrangement of the mechanism actuating the spring, its tension (or compression or equivalent distortion) is weaker toward the end of the making of a cop than at the beginning. Hithereto, but little attention has been paid to this fact and therefore its disadvantageous consequences have not been recognized, and since the present invention has arisen through careful observation of the fact referred to, it is necessary to explain shortly the operation of backing-off with reference to the accompanying diagrammatic illustrations of which,

Figure 1 represents the gear in question in a known type of machine, and Figs. 2^a and 2^b, the gear of a self-acting mule of another known type. Figs. 3 and 3^a are details of adjusting devices applicable to the machine of Fig. 2^a. Figs. 4^a and 4^b are side and end views respectively of another adjusting device. Figs. 5^a and 5^b are end and side views respectively of still another adjusting device. Figs. 6^a and 6^b are end and side views respectively of still another adjusting device. Figs. 6^c and 6^d are respectively a side elevation and a plan of still another adjusting device. Figs. 7^a and 7^b are respectively an end and a side elevation of still another adjusting device. Figs. 8^a and 8^b are similar views of still another adjusting device. Figs. 9^a and 9^b are similar views of still another adjusting device. Figs. 10^a and 10^b are respectively an end and a side view of still another adjusting device. Figs. 11^a and 11^b are side elevations of still another adjusting device, in different positions of adjustment. Fig. 11^c is a side elevation of a slightly modified form of the device of Figs. 11^a and 11^b. Figs. 12^a and 12^b are side elevations of still another adjusting device, in different positions. Figs. 13^a and 13^b are side elevations of still another adjusting device, in different positions. Fig. 13^c is a similar view of a slightly modified form of the device of Figs. 13^a and 13^b. Figs. 14^a and 14^b are respectively an end and a side elevation of still another adjusting device. Figs. 15, 16 and 17 are side elevations of still other adjusting devices differing but slightly from one another. Figs. 18, 18^a and 18^b are side elevations of still another adjusting device in different positions. Fig. 19 is a side elevation of a device constituting a slight modification of that in Fig. 18. Figs. 20^a and 20^b are side elevations of still another adjusting device, in different positions. Figs. 21^a and 21^b are similar views of still another adjusting device. Figs. 22^a and 22^b are similar views of an adjusting device for a weight-controlled lever. Fig. 23 is a similar view of an adjusting device for an electrically controlled lever.

During the spinning operation the main shaft with the whirl S which drives the spindles, is turned from the drum F fixed on the shaft, while the specially driven backing-off brake wheel A which is loose on the shaft is always rotated in the opposite direction. For the purpose of backing-off the

wheel A is shifted axially by means of the lever J, so that it is frictionally coupled with the fixed drum F and first brakes the driving shaft and then turns it in the opposite direction. The brake lever J is actuated by a spring f_4, which according to Fig. 1 is arranged on the shifting rod 16 and bears at its right end against an adjusting ring r mounted on the rod 16. The rod 16 itself passes freely through an opening in the lever J. In the position of rest, according to Fig. 1, the rod 16 is held against a stop 16_1 by means of a spring 17_1 acting on an angle lever 17 which is pivoted in the outer headstock of the machine, so that the spring f_4 is extended. On the carriage is a pivoted fork G which at the end of the outward movement of the carriage presses with its upper prong on the pin Q upon the end of the horizontal arm of the angle lever 17; whereupon the shifting rod 16 moves to the left in the direction of the arrow 1, and the spring f_4 is strained by the adjusting ring r. At the same time by the action of the nose 13 carried by the lever 14, the lever 12 of the carriage coupling is held up. The strained spring f_4 cannot however move the brake lever J, since the latter is held by the stop 24 and lever 23 which is controlled by the feeding shaft or in case of an after-twist by the counting mechanism.

When the lever 23 snaps to the left toward the end of the spinning operation, the stop 24 releases the backing-off brake lever J, the strained spring f_4 can operate the lever in the direction of the arrow 1, the brake wheel A couples with the drum F and turns the main shaft and its spindles in the backward direction until the faller-lever a is moved backward to the unwinding position, and the faller-lever leg h which is connected with the fork G through the link p and is moved upward in the downward movement of the faller-lever, snaps with its lower shoulder over the roll r_2 by reason of the pull on the spring f_8. Thus the fork G is so turned that its upper prong releases the angle lever 17, and then the spring f_4 assisted by the spring 17_1 operating on the angle lever 17, moves the rod 16 quickly to the right until it strikes the stop 16_1. The result is that the shoulder 25 carried by the rod 16 strikes against the lever J and moves the brake out of engagement. At the same time the nose 13 is withdrawn to release the lever 12, so that the coupling for the inward movement is effected and the inward movement of the carriage can begin.

The roller r_2 is carried on a slide U which rises and falls on a vertical guide on the carriage by reason of a roller o running on the copping-rail f. As the making of the cop progresses the inclines P are gradually shifted automatically toward the rear part of the main frame by means of the worm shaft B geared to any suitable part of the mechanism, the copping-rail f falls progessively, and with it the roller r_2. Consequently the faller-lever leg h rises progressively to a lower point with each reciprocation of the carriage, and the faller a moves downward to a less extent. Toward the end of the making of a cop the leg h will thus lift less than at the beginning when the spindle is empty. As the roller r_2 takes a lower position, the lower end of the leg h moves more to the left, so that its position becomes more nearly vertical; the fork G through its connection by the link p with the leg h and under the influence of the spring f_8 is therefore turned more to the left. It occurs thus that the upper prong of the fork G comes to lie in higher and higher positions, and the angle lever 17 is turned so much the less at the end of each outward movement of the carriage as the making of the cop progresses, the rod 16 is shifted a shorter distance, and the spring f_4 is strained to a less degree. The backing-off action therefore becomes more sluggish toward the end of the making of the cop, the present explanation shows that for one part this sluggishness is due to the arrangement of the mechanism operating the rod 16, but in the other part primarily upon the increasing mass of the cop.

In the spinner of Figs. 2^a and 2^b the backing-off brake lever J is two-armed, and the operation of the brake results from a movement of the lower arm of the lever J to the right. To effect this movement this arm is connected through a pulling spring f_4 with the shifting rod 16 in such a way that the right end of the spring f_4 is fastened fixedly to a rod f_1, passing through an eye 16_0 on the shifting rod 16, and is secured by nuts r_0 at opposite sides of the eye.

Toward the end of the outward movement of the carriage the roller G_1 of the lever G in the carriage strikes the stop Q_1 carried on the shifting rod 16 and shoves the latter to the right against the action of the spring 17_1, of which the left end is fastened to the frame and the right end to the rod 16. As the lever J is held likewise as described in connection with Fig. 1 by the stop 24, the shifting of the rod 16 to the right first effects only a tension of the spring f_4. At the end of the spinning operation the stop 24 snaps to the right, the lever J obeys the tension of the spring f_4, the brake is moved into engagement, and the main driving shaft is turned as previously described in the opposite direction until the faller-lever a is moved backward to the unwinding position, and the leg h which is connected with the lever G through the link p and which by the downward movement of the faller a is lifted, snaps with its lower notch over the projection r_3 of the slide U by reason of the pull of the spring f_8. In this way the lever G is

turned so that it releases the shifting rod 16, which then under the action of the springs f_4 and 17_1 snaps to the left, and with its left end shifts the lever J so that the brake is released. In this mechanism as well the lower end of the faller leg h is shifted more to the left toward the end of the making of the cop, so that its position becomes more nearly vertical; the lever G under the action of the spring f_8 lies in a position more to the left; the rod 16 which is shifted by the roller G_1 at each outward movement of the carriage is shoved a shorter distance to the right; and consequently the spring f_4 is less strained. Thus with this type of self-acting mules shown in Figs 2^a and 2^b the backing-off action is more sluggish toward the end of the making of a cop than with empty spindles.

The spring f_4 is not readily adjustable in either of the cases described. The ring r of Fig. 1 is adjustable on the rod 16, and the spring f_4 of Figs. 2^a and 2^b is held fast by means of two nuts lying on the opposite sides of the eye 16_0, and can be adjusted, but these mechanisms are designed to permit an adjustment only occasionally, when for example the backing-off brake acts always too strongly or too weakly, when a new brake is to be introduced or to be regulated, or when the spring f_4 has become weakened. Neither in these nor in any previous machines has it been possible to change the tension or strain of the spring during the making of a cop; consequently heretofore the pressure on the backing-off brake lever has always grown less toward the end of the cop building, there has been no provision for strengthening the pressure on the brake toward the end of the making of a cop as according to the present invention. Only in some old types of self-acting mules has there been obtained a uniform pressure during the entire making of the cop, resulting from the manner of control of the brake lever. It is also to be observed that heretofore the initial tension of the spring f_4 could not be set stronger than was necessary for a correct backing-off with the spindles empty. Consequently during the increase in the size of the cop, the tension remained considerably behind that which would be necessary in order to keep it corresponding to the greater mass of yarn, in order to bring the spindles to rest without affecting the backing-off and to transmit backward rotation thereto. On the other hand if the spring f_4 would be strained so strongly as to accomplish properly the backing-off of the nearly filled spindles, then the empty spindles were too strongly braked, the backing-off was effected too quickly, and the quadrant chain would become entangled and the belts or cords for driving the drums and the spindles were very apt to jump out of their grooves. According to the present invention, however, the pressure on the brake increases gradually with the increasing cops, so that the driving shaft and all parts serving for the movement of the spindles, as well as the spindles themselves, can always be brought to rest in about the same length of time without injuriously affecting the backing-off parts or any other part of the mechanism. An important result of this improvement, besides avoiding the disturbance of the operation, is the increasing of the output of the self-acting mule within a given time. It has been determined by experiment that the permissible brake pressure should increase not necessarily at exactly the same rate as the mass of the cop, but according to a determined rule. The operation can be effected by increasing the tension of the spring f_4 by hand or by mechanism which carries out the work automatically according to a determined rule. Instead of spring pressure, any other sort of pressure may be utilized, such as the pressure of a weight, the pull of an electro-magnet, the pressure of gases or the like. The increase in size of the cop as an indication of its increasing weight, will thus play the chief part; thereby it is of no consequence whether there is used the mechanism already existing for the making of the cop in self-acting mules such as the screws operating the inclines, the direction and position of the roll-carrying slide, the slide itself, the fork in its form and in the height of its position, the faller-lever, the length of the link p, the shifting of the point of connection of p with the faller-lever leg, the elevation of the roller Q of the lever 17, the shortening of the lever 17, or the corresponding parts of the mechanism of other styles of self-acting mules and the like. There can also be utilized the changing of the proportions of the lengths of the levers, or the shifting of engagement points. Furthermore there can be utilized forces added to those already provided in the driving mechanism, as for example auxiliary springs or weights which act with varying power arms; also the degree of positive pressure may be increased by the reduction of a negative pressure, that is to say, a resistance which exists in the beginning of the making of a cop, may be decreased during the operation. Thus the pressure of the brake spring f_4 can be increased by reducing the pressure of an opposing spring, either by acting directly upon the latter spring, or by properly shifting its point of engagement. Finally newly added mechanism may be used which either takes over the making of a cop, or which runs in a measure parallel with the cop making parts.

From these observations it appears that the practical embodiment of the invention

in a suitable backing-off brake mechanism can be effected in many ways. There may be in fact retained the mechanism of the known types of self-acting mules and change their operation only in the desired direction, or there may be used the known mechanism but in reversing its operation from the beginning; or there may be connected and arranged the different mechanisms with one another, or there may be introduced entirely new mechanisms, as for example a new screw which only follows and does not cause the making of the cop. Furthermore there may also be used for such purposes the backing-off brake mechanism of machines which at present operate without any special elastic brake pressure. But in all cases it is important to increase the brake pressure with the increasing size of the cop.

Figs. 3 to 23 inclusive of the accompanying drawings illustrate various embodiments of the invention more or less diagrammatically. In the simplest form of the invention the mechanism is designed to permit a regulation of the tension of the spring f_4 by hand as gradually as the making of the cop progresses. In a known type of self-acting mules the spring f_4 must be compressed to effect the brake pressure. The same is true of the self-acting mules of other types; while in the machine of Figs. 2^a and 2^b, as already explained, the spring acting on the backing-off brake lever is not compressed but drawn out to effect the desired pressure on the brake. In both cases the point at which the controlling or shifting rod 16 puts a strain upon the spring f_4 must be so changed as the cop increases, that the spring will be more strongly strained. For this purpose according to Fig. 3, the rod 16 is provided with an adjustable fixed screw s carrying a nut m supporting the right end of the spring f_4. At the beginning of the spinning operation the nut m is screwed back so far on the screw s, and the screw s is so fastened on the rod 16 by the adjustable ring r, that the spring f_4 is strained to exert a proper brake pressure for the correct backing-off with empty spindles. As the cop grows the nut m is turned by hand so that the spring f_4 increases in strength. Instead of having the screw s fast with and adjustable to the rod 16, the nut m may be adjustably fastened on the rod so that the screw s would have to be turned and the spring f_4 would bear against the screw.

In the self-acting mule of Figs. 2^a and 2^b the nut must be so arranged as to be easily turned by hand. For this purpose for example the arrangement of Fig. 3^a may be adopted. In the eye 16_0 of the shifting rod 16 is the nut m which screws on the tension rod f_1 of the spring f_4, the nut being rotatable but not movable longitudinally, so that by turning it the tension rod is moved backward or forward in order to increase or diminish the tension of the spring. The nut m can be turned by hand, in which case it is preferably provided with wings. Or the nut may be rotated by suitable mechanism. A similar purpose is served by the mechanism of Figs. 4^a and 4^b, in which a lever H is pivoted at i to the lower arm of a sleeve L fastened on the shifting rod 16, and is operated by a screw s which screws through the upper end of the sleeve. An oblong aperture is provided in the lever H for the passage of the rod 16 (see Fig. 4^b) and the spring f_4 abuts against the lever H so that by turning the screw s as the making of the cop progresses, the tension of the spring may be increased.

The device of Fig. 3 may be easily adapted for automatic operation by connecting the nut m (or the screw s) with a mechanism affected continuously or interruptedly by the driving mechanism (ratchet gear) of the machine, by which the nut is turned slowly, so that with the increase of the cop the tension of the spring f_4 will be correspondingly increased. For this purpose for example the nut m (Figs. 5^a and 5^b) may be provided with a pinion Z which engages a long pinion Z_1 on the shaft W, so that the shifting rod 16 with the nut m can have its longitudinal movement without disconnecting the pinions. By means of sprocket wheels R_1 and R_2 the turning of the screw B of the inclines is transmitted to the shaft W. After the completion of the cop the inclines are returned as usual, whereupon also the nut m returns to its original position. With such an arrangement the nut m turns correspondingly with the increase of the cop. In some cases this approximation is sufficient, while in other cases it is advisable to strain the spring f_4 more strongly after each backing-off during the beginning of the making of the cop, but to strain it less strongly later. This operation may be effected in the mechanism of Figs. 5^a and 5^b, in providing the screw s with variable pitch and substituting the nut by a slide which has a tooth engaging with the threads of the screw s. In the mechanism of Figs. 6^a and 6^b the same effect is obtained by employing for the straining of the spring f_4 a cam disk the edge of which bears against the sleeve C sliding on the rod 16 and supporting the end of the spring f_4 and which is carried on a shaft W_1 arranged at right angles to the rod 16. On the same shaft W_1 is fastened a worm gear R which is rotated by a worm N which is feathered on the shaft W rotated from the screw B of the inclines by means of sprocket wheels R_1 and R_2, and which is arranged to slide on the shaft W so that it partakes of the rotary movement thereof,

but may move axially relatively thereto. The bearing L of the gear R and cam E is clamped fast on the rod 16, and has a fork *g* engaging a groove in the rotating hub of the worm N so as to cause the latter to partake of the backward and forward movement of the rod 16, and to remain always in engagement with the worm gear R. The rate of transmission between the screw B of the inclines and the cam E must be so measured that the cam must not make a complete revolution during the building of one cop. The amount by which the spring must be strained from the beginning to the end of the cop building, will be determined by the form of the cam E. The form of the cam will be determined by practical investigations for the particular cases in hand. On the return of the screw B of the inclines there follows the movement of the slide C and the spring f_4 to their original positions. A similar arrangement may be adapted to the spinner of Figs. 2^a and 2^b according to Figs. 6^c and 6^d, in which for the tension of the spring f_4 a cam E is arranged on a shaft W_1 which is fixed unshiftable in bearings upon the rod 16, and which by means of pinions Z Z_1, shaft W, and sprocket wheels R_1 R_2 is rotated from the screw B of the inclines as in Figs. 5^a and 5^b. The pinion Z_1 is so long as to maintain engagement with the pinion Z during the reciprocation of the rod 16.

While in the mechanism just described the tension of the spring f_4 operating the brake lever J is continuously changed through the rotary movement of the screw B of the inclines, an apparatus is shown in Figs. 7^a and 7^b which utilizes the movement of the forward incline P. On the rod 16 a sleeve L is clamped fast in which the shaft W is arranged at right angles to the rod 16 and carries at one end a cam E and at the other end a wheel R_3 with a ratchet S^p, in the teeth of which engages a pawl *k*. About the edge of the wheel R_3 is arranged a chain K with its end fastened to the wheel, while its other end is connected to a two-armed lever H_1 pivoted at a fixed point i_1; and with its lower end linked to the forward plate P of the inclines. Between the spring f_4 and the cam E is a sleeve C sliding on the rod 16 and following the movement of the cam, and against which the spring presses. As the cop increases, the incline P shifts gradually in the direction of the arrow to the left, the chain K turns the wheel R_3 and the cam E so that the compression of the spring f_4 is increased. On the snapping of the rod 16 to the right, the chain becomes loose, but the cam E is prevented from turning backward by the pawl and ratchet. After the completion of a cop the pawl *k* must be lifted and the cam E turned back.

In the apparatus of Figs. 8^a and 8^b the chain is replaced by a rack Z_2 which by means of a pinion R_4 in engagement with it turns the cam E. In this device the cam E is turned forward and backward with each forward and backward movement of the rod 16, since the rack Z_2 does not take part in the movement of the rod 16, the pinion R_4 thus rolling over the rack Z_2. After the completion of a cop and the return of the incline screw, the cam E turns back to its starting position.

According to Figs 9^a and 9^b the movement of the incline P is transmitted to a slide L_1 L_2 on the rod 16 by means of a lever mechanism, the spring f_4 being supported against the slide, and the slide being provided with a ratchet Z_3 between whose teeth a pawl *k* can fall so as to prevent the backward movement of the slide. The frame L which carries the pawl *k* and on which also the two-armed lever H_2 is pivoted, which lever H_2 effects the movement of the slide, is fastened to the rod 16 so that its position thereon does not change. The lever H_2 is connected by a rod *l* with a swinging lever H_1 pivoted at i_1, the lever H_1 being operated by the forward incline P. At the beginning of the cop building the slide L_1 L_2 is in its extreme position to the right and the spring f_4 is strained to the point necessary for backing-off with empty spindles. With the increase of the cop the incline P and the slide L_1 L_2 move gradually to the left, the lever H_2 acting on the slide L_1 and L_2 so that the spring is strained more and more strongly. On the snapping back of the rod 16 to the right, the slide L_1 L_2 by means of the pawl *k* is held fast in its position on the rod 16, and the pin at the upper end of the lever H_1 must have a certain amount of play in the rod *l* which connects it with the lever H_2, as shown in Fig. 9^a. As the cop building progresses the pawl *k* engages the teeth farther and farther to the right on the ratchet Z_3. The rule according to which the pressure on the backing-off brake lever is to change, must be transferred to the form of the cam D of the lever H_2 and the surface D_2 of the slide L_2. Also by the position of the pivot pin *i* relatively to the incline P and the shifting thereof, the uniform steps may be transposed into un-uniform ones.

In the construction of Figs. 10^a and 10^b the straining of the spring f_4 is effected by the turning movement of the faller-lever shaft *d*, which during the run-in movement of the carriage when the spindles are empty is greater than when they are full. The nut *m* is slidable on the rod 16, but is feathered to prevent rotation thereon. A worm gear R is fast on the screw *s* which is rotatable on the rod 16, but is held against sliding movement, and the gear R is rotated by means of

the worm N. The shaft W of the worm N carries a ratchet wheel S^p, and on the shaft W is a freely rotatable intermediate lever H_3 carrying a pawl *k* adapted to engage the teeth of the ratchet wheel S^p. On the run-in movement of the carriage the faller-lever shaft *a* carried thereon moves also in the direction of the arrow 1 (Fig. 10[a]), that is, toward the left, whereupon a cam V on this rod strikes the end of the lever H_3. At the beginning of the cop building the shaft *a* is turned so far that the cam V in its most projecting point acts on the lever H_3. Toward the end of the cop the rod *a* is turned only a little, so that a less projecting point of the cam V strikes the lever H_3. Accordingly in the first case the lever H_3 will be turned farther than in the second case, so that as the turning of the rod *a* becomes less with the increase of the cop, so also the operation of the wheel S^p and the amount by which the spring is further distorted decreases. After the completion of a cop the worm N will be lifted out of the worm gear R by means of a lever H_9 pivoted at i_2 and carrying the shaft W at its end, and the screw *s* will be turned back to its original position. If with this construction in place of the screw with a nut thereon there were to be used a laterally acting cam with a sliding sleeve as in Figs. 6[a] and 6[b], the adjustment effected by the faller shaft can take place uniformly, then the faller shaft should not need to be provided with a cam but might have a simple striker; or there might be arranged a striker on any other part of the carriage which on the inward movement or on the outward movement of the carriage would operate the lever H_3. The tension of the spring f_4 can also be changed by means of the slide U (Fig. 1) of the carriage which is lowered more and more in the course of making a cop. For this purpose there is shown in Figs. 11[a] and 11[b] a two-armed lever H_5 pivoted at i_3 on an arm of the rod 16, the upper end of the lever terminating in a fork supporting the end of the spring f_4, while the lower arm of the lever is engaged toward the end of the outward movement of the carriage by a nose U_1 on the slide U. As the rod 16 is then shifted by means of the lever 17 in the direction of the arrow 1, the pivot i_3 takes part in the movement, so that the lever H_5 with its lower end in engagement with the nose U_1 is so turned as to increase the pressure on the spring f_4. As the cop building progresses the slide U becomes lower (Fig. 11[b]), and by reason of the shape of the lower arm of the lever H_5 the lever is further turned on its pivot, and the spring is more strongly strained, exactly as in the action of the cam E of Fig. 6[a]. Preferably the slide U is loaded with a special weight or a downwardly operating spring. As soon as the rod 16 is again shifted to the right, there is a corresponding expansion of the spring f_4. With this mechanism the spring f_4 is not directly strained by the rod 16, and the spring may be arranged (Fig. 11[c]) on a special rod 16_2. Similarly in all cases in which the straining of the spring f_4 is not directly effected by the rod 16, the spring may be arranged independently of this rod, as for example upon a separate rod.

In a further group of embodiments of the invention there is a change of the strain of the spring f_4 by means of the angle lever 17. For this purpose (Figs. 12[a] and 12[b]) a second angle lever 18 is pivoted loosely on the pivot i_4 of the lever 17, and has its vertical arm formed in a fork about the rod 16 and supporting the right hand end of the spring f_4. Between the horizontal arms of the levers 17 and 18 a wedge K_1 may be arranged to enter toward the end of the outward movement of the carriage, said wedge constituting the end of an angle lever H_6 pivoted on the pin i_5 on the slide U, and whose vertical arm is weighted. Now when the angle lever 17 (described with reference to Fig. 1) toward the end of the outward movement of the carriage is shifted by the fork G (Fig. 1) there results also by the intermediation of the wedge K_1 a turning of the angle lever 18, and thereby a strain upon the spring f_4. At the beginning of the cop building (Fig. 12[a]) the slide U occupies a higher position, so that the wedge K_1 enters only slightly between the levers 17 and 18. As the cop building progresses (Fig. 12[b]) the slide U is lowered and the wedge K_1 penetrates more deeply between the levers 17 and 18, so that these levers are more widely separated from each other, and the same amount of turning of the lever 17 produces a greater rotation of the lever 18 and an increased strain on the spring f_4. By suitable shaping the wedge K_1 and the surfaces of the levers 17 and 18 which come into engagement with the wedge, the spring f_4 can be un-uniformly strained in the course of the building of a cop, the same as with the cam E in Fig. 6[a].

In the arrangement shown in Figs 13[a] and 13[b] the wedge K_1 which enters between the vertical arm of the angle lever 17 and the lever 18 which is freely pivoted on the pivot i_4, is shifted by the copping rail *f* with which it is connected by means of a rod K_2. As the copping rail *f* is lowered in the advancement of the cop building (Fig. 13[b]) the wedge K_1 is also lowered, so that it presses the levers 17 and 18 farther apart, so that by the same movement of the lever 17 the lever 18 exerts a greater strain upon the spring f_4. Also in this case by the special shaping of the wedge K_1 and the surfaces of the levers 17 and 18 engaged therewith, there can be obtained an un-uniform

increase of the tension of the spring f_4 as the making of the cop progresses. Fig. 13^c shows how with this mechanism the spring f_4 may be carried on a special rod 16_2.

Instead of using a wedge, the separating of the levers 17 and 18 can be effected by means of a cam (Figs. 14^a and 14^b). The cam E is in this case arranged on the horizontal arm of the angle lever 18 which is pivoted on the pin i_4, and its shaft W is provided with a worm gear R with which engages a worm N likewise fastened on the horizontal arm of the lever 18, the worm N being operated by the sprocket wheels R_1 R_2 from the incline screw B, as described with reference to Figs. 5^a and 5^b. The cam E bears against the third arm 19 connected with the angle lever 17. Between the right hand end of the spring f_4 and the fork of the vertical arm of the angle lever 18 there is a nut m constituting a slide, and a tube x provided with a thread, so that by turning the sleeve m or the tube x the tension of the spring f_4 can be exactly regulated. This tension apparatus may be used with all the embodiments of the invention. In this case also the spring f_4 can be arranged upon a special rod. The angle lever 18 whose vertical arm serves to strain the spring f_4 can also be supported upon the horizontal arm of the angle lever 17, and more particularly upon the pin of the roller Q on which works the fork G described with reference to Fig. 1. Care must be taken in this case that on the turning of the angle lever 17 the other arm of the lever 18 is so supported that a turning of this lever results which, as the making of the cop progresses, is gradually increased uniformly or un-uniformly. Figs. 15, 16 and 17 show three different constructional forms of this mechanism.

According to Fig. 15 the right end of the horizontal arm 18_1 of the angle lever 18 is supported on a lateral pin t of the lever H_7 rotating about the pivot i_5. Thus when the lever 17 is turned by the fork G of the running-out carriage, the tail of the lever arm 18_1 rests on the pin t, and the lever 18 is turned so as to strain the spring f_4. This spring may also be arranged upon a special rod, as is shown in connection with Figs. 11^c and 13^c. The lever H_7 is adjusted by the incline P, and the tail of the arm 18_1 is so shaped that as the making of the cop progresses a greater turning of the lever 18 and a stronger straining of the spring f_4 results.

The modification in Fig. 16 differs only from that just described, in that the pin t of the lever H_7 has a curved forearm t_1.

In the construction of Fig. 17 the arm 18_1 of the lever 18 bears against a cam plate C which may be connected with the incline of the machine, or which may be horizontally moved by the incline screw B in such a way that as the making of the cop progresses the lever 18 is more turned and the spring f_4 is more strongly strained. The increase of the pressure operating on the backing-off brake can also be obtained by means of an auxiliary spring which either increases the strain on the main spring as the making of the cop progresses, or works independently of the main spring on the backing-off brake lever.

Fig. 18 shows a mechanism of the first class. The main spring f_4 acting on the backing-off brake lever J, exerts in its position of rest that amount of pressure which exists in the previously described mechanisms first on the movement of the rod 16 to the left by means of the fork G (Fig. 1). The brake lever, however, cannot yield to the pressure of the spring pressing on it, since it is supported by the ring 25 mounted fixedly on the rod 16, and the rod 16 cannot in the position of rest be moved to the left. The spring f_4 bears with its right end against a ring r_1 which is slidable on the shifting rod 16, and is carried on an angle lever H_8 pivoted at i_6 whose horizontal arm bears against a cam plate C on the copping rail f. The auxiliary spring f_5 bears at the left against the ring r_1 and at the right against the ring r adjustably fixed to the rod 16. This spring f_5 is considerably more strained than the main spring f_4, and simultaneously effects the shifting of the rod 16 to the right, as soon as the backing-off is ended. As the making of the cop progresses the copping rail sinks with the cam plate C as shown in dotted lines. The lever H_8 with the ring r_1 partakes of this movement, so that a stronger pressure is exerted on the backing-off brake lever as is shown in Figs. 18^a and 18^b. The main spring f_4 may be so strained in the position of rest of Fig. 18, that it can exert a pressure of about 10 kilograms for effecting the engagement of the brake at the beginning of the making of the cop, while the auxiliary spring f_5 may be so strained as to effect a pressure of 30 kilograms. Since the ring r_1 is held in its position by the lever H_8, the spring f_5 seeks to force the shifting rod 16 to the right exactly as in Fig. 1; the spring 17_1 seeks to press the rod 16 to its position of rest. If now by the outward movement of the carriage the lever 17 is turned so that it takes the position of Fig. 18^a, the rod 16 with the rings r and 25 is shoved to the left, but since the ring r_1 is immovable, only the strain on the auxiliary spring f_5 is increased, about to 32 kilograms, while the spring f_4 moves the lever J forcibly against the stop 24 which holds the lever J (as described with reference to Fig. 1), until the feeding shaft or in case of an after-twist, the connecting mechanism withdraws the stop 24. Then the main spring f_4 can operate the backing-off brake lever J, by

which action the spring f_4 will be somewhat extended, as to 9 kilograms (Fig. 18[b]). When now at the end of the backing-off operation the angle lever 17 is released, the shifting rod 16 can under the operation of the auxiliary spring f_5 bearing against the ring r_1, move to the right, whereby the ring 25 strikes the backing-off brake lever and compresses the main spring f_4, which parts are thus brought again to the position shown in Fig. 18. Since the position of the ring 25 is determined by the stop 16_1 of the rod 16 and remains fixed in the course of making a cop, therefore by the adjusting of the ring r_1 to the left to the dotted line position of Fig. 18, the main spring f_4 is more strongly strained by the auxiliary spring, so that thus the strain on the auxiliary spring f_5 diminishes for example to 28 kilograms and the strain on the main spring increases, say to 12 kilograms. Therefore as the making of the cop progresses the pressure on the backing-off brake lever J increases. By the special design of the cam plate C mounted on the copping rail f, the amount of shift of the ring r can be accommodated to the progressive building of the cop.

Instead of arranging the loose ring r_1 on a lever H_8, any other arrangement may be adopted for supporting the ring. For example as shown in Fig. 19 the ring may be supported at its left by a cam E which is carried upon an immovable shaft W and is turned by any suitable mechanism in the direction of the arrow, so that it causes the auxiliary spring f_5 to increase the strength of the main spring f_4 little by little.

Instead of straining the main spring more strongly by an auxiliary spring as the making of the cop progresses the auxiliary spring may also be made independently as an additional spring working on the brake lever. The strain on the main spring would then remain unchanged, while the supplementary or additional spring would be more and more strongly strained as the making of the cop progresses. According to Figs. 20[a] and 20[b] the additional spring f_5 rests on a second rod 16^2 guided in the frame while the main spring f_4 bears against the ring r fixed on the shifting rod 16. The additional spring f_5 bears against the curved edge of a cam lever 18_2 which is pivoted on the pin i_6 which connects the angle lever 17 with the shifting rod 16. This cam lever 18_2 is connected by means of a rod K_3 with the copping rail f and follows also the movement of this track. The fork G of the outwardly moving carriage turns the angle lever 17 as in Fig. 20[b], whereupon not only the main spring f_4 by the movement of the rod 16, but also the additional spring f_5 by the action of the cam lever 18_2, is strained. The two springs act on the brake lever J and as the making of the cop progresses the cam lever 18_2 is lowered, so that the spring f_5 is more strongly strained. With this arrangement also the spring f_5 alone might be used to effect the pressure on the brake lever J and it could then also be arranged on the rod 16. The cam lever 18_2 could also be pivoted upon a pin arranged somewhat lower on the vertical arm of the angle lever 17.

In the mechanism of Figs. 21[a] and 21[b], the additional spring f_5 is strained by an angle lever 18 rotatable about the pin i_4 of the angle lever 17. On the horizontal arm 18_1 of this angle lever 18 operates an expansion spring f_6 whose engagement point is adjusted by the shifting of the rod 16. The spring f_6 fastened at its lower end to the frame, is at its upper end provided with a roller o_1 which can slide on the horizontal arm 18_1 of the angle lever 18. This roller o_1 is engaged by the fork n of a single arm lever M which is pivoted on the pin i_7 at the upper end of the lever H_9 and is engaged between two rings r_2 which operate together on the shifting rod 16. The two-armed lever H_9 is pivoted at l_8 and bears at its lower end against a support C_1 which is shifted by the incline screw B. In the position of rest the parts of the mechanism are shown in Fig. 21[a]. When the angle lever 17 is turned by the fork G of the outwardly moving carriage so that the lever 17 and the rod 16 take the positions shown in Fig. 21[b], the lever M also turns about its pivot i_7 so that the fork n of this lever shoves the roller o_1 of the spring f_6 out along the lever arm 18_1, so that the spring has a longer power arm y, and accordingly the additional spring f_5 is strained until a balance is reached between the springs f^5 and f^6. At the end of the backing-off operation the parts return to the position of Fig. 21[a]. When the support C_1 is shifted to the dotted lines position, as the making of the cop progresses the levers H_9 and M take the positions also shown in dotted lines. The pivot pin i_7 of the lever M is shifted to the right, the roller o of the spring f_6 separates still farther from the pivot point i_4 of the lever 18 so that already from the first the spring f_6 operates with a greater power arm on the horizontal arm 18_1 of the angle lever 18, and on the turning of the angle levers 17 and 18 to the positions of Fig. 21[b] therefore the strain exerted by the additional spring f_5 is so much the greater. If the horizontal arm 18_1 were not straight as shown but were bent shaped, the force transmitted by the lever 18 on the additional spring f_5 can be altered with the greater deflection of the lever M as the cop making progresses. Also by means of the shape of the bearing surface of the support C_1, the throw of the lever H_9 can be so changed that for a uniform movement of the support C_1 the amount by which the

strain on the additional spring increases as the cop building progresses would be changed. Also with this apparatus the spring f_5 alone can exert the pressure on the backing-off brake lever as previously described and may also be arranged upon the shifting rod 16.

With the previously described apparatus it has been assumed that the backing-off brake lever was pressed by a spring. Instead of such a spring a weight may be employed. The variation of the braking pressure may then be accomplished by the shifting of the weight. Figs. 22[a] and 22[b] show schematically such an apparatus in two different forms. On the shifting rod 16 is supported an angle lever H_{10} rotatable about a pin i_9 and whose horizontal arm carries the weight g_2 serving to effect the pressure to the backing-off brake lever. The vertical arm of this lever g_2 is provided with a stop i_{10} and is linked to a stop rod s_3 which passes freely through a hole in the brake lever J, but which carries in front of the lever a collar s_4. Fig. 22[a] shows the position of the parts when at rest. When the rod 16 toward the end of the outward movement of the carriage as described with reference to Fig. 1, is shifted in the direction of the arrow 1, that is to say, to the left, the parts assume the position of Fig. 22[b]. The pin i_9 follows the movement of the rod 16. Thereupon the collar s_4 of the stop rod s_3 strikes the lever J and by the further movement of the rod 16 the lever H_{10} turns, so that the weight g_2 is lifted. If a lever 23 then releases the brake lever J, the weight g_2 by means of the lever H_{10} and the push rod s_3 effects the pressure on the brake lever exactly as with the previously described spring f_4. In order to increase the pressure on the brake lever as the making of a cop progresses, the weight g_2 is slid along the horizontal arm of the lever H_{10}, as for example by means of the cam E or a screw which receives its movement from any part of the machine, as from the copping rail or from the incline in a way similar to that shown in connection with the worm N of Figs. 6[a] and 6[b] or 14[a] and 14[b].

The mechanism is extremely simplified if an electro-magnet is employed for the pressing of the brake lever. The brake pressure can then be increased in a very simple manner as the making of the cop progresses, by introducing more windings for instance by the sliding of an iron core. Fig. 23 shows schematically such a device. The backing-off brake lever J is connected by the lever H_{11} with the iron core E_k of the electro-magnet. At the beginning of the backing-off the electric current is closed by suitable mechanism, and the core E_k pulls the lever J. as the making of the cop progresses the cam E is turned in such a way that the iron core E_k enters more deeply into the coil and the brake pressure is increased. After the completion of the backing-off the current is cut off. Also the brake pressure can be increased by the addition of windings as the making of the cop progresses.

In order to use the different backing-off brake mechanisms for different numbers of yarn the controlling parts, such as the wheels R_1 R_2, the cam E, the wedge K_1 and the like, may be made in several sizes and removable.

I claim as my invention:

1. Backing-off brake gear for self-acting mules comprising a backing-off brake, pressure operated means for applying the brake, and means for increasing pressure of the brake-applying means as the building of the cop progresses.

2. Backing-off brake gear for self-acting mules comprising a backing-off brake, spring operated means for applying the brake, and means for increasing the tension of the spring of the brake-applying means, as the building of the cop progresses.

3. Backing-off brake gear for self-acting mules comprising a backing-off brake, a spring for applying said brake, a cam adapted to vary the tension of said spring as the building of the cop progresses, and connections between the cam and the mule for operating the cam.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

JOHANN GEORG BODEMER.

Witnesses:

HEINRICH RICHARD BELLMANN,
FRIEDRICH WILHELM RAMM.