No. 827,825. PATENTED AUG. 7, 1906.

H. B. STOCKS.

PARTY LINE SYSTEM OF TELEPHONES.

APPLICATION FILED SEPT. 5, 1905.

5 SHEETS—SHEET 1.

Fig. 1.

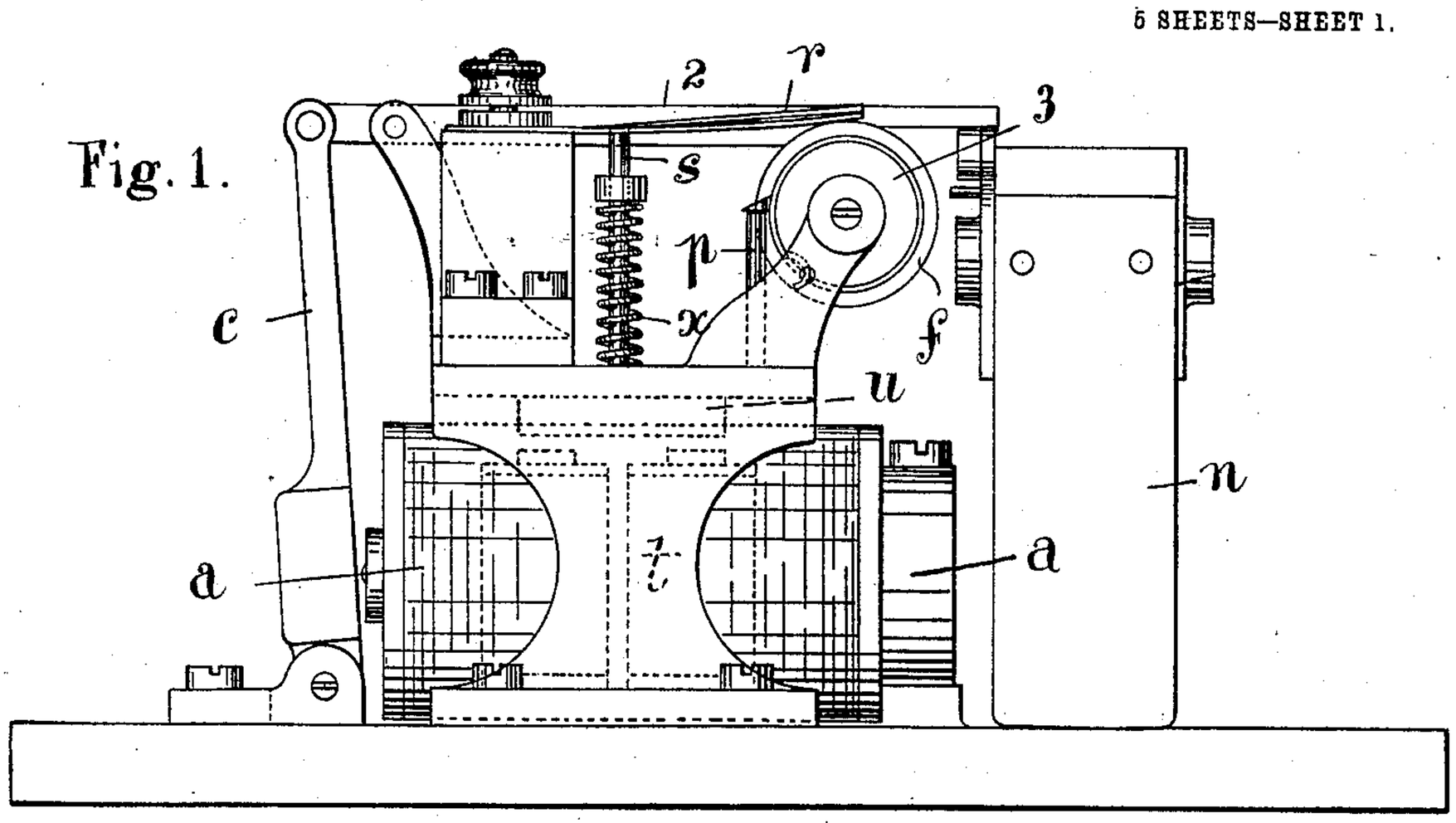
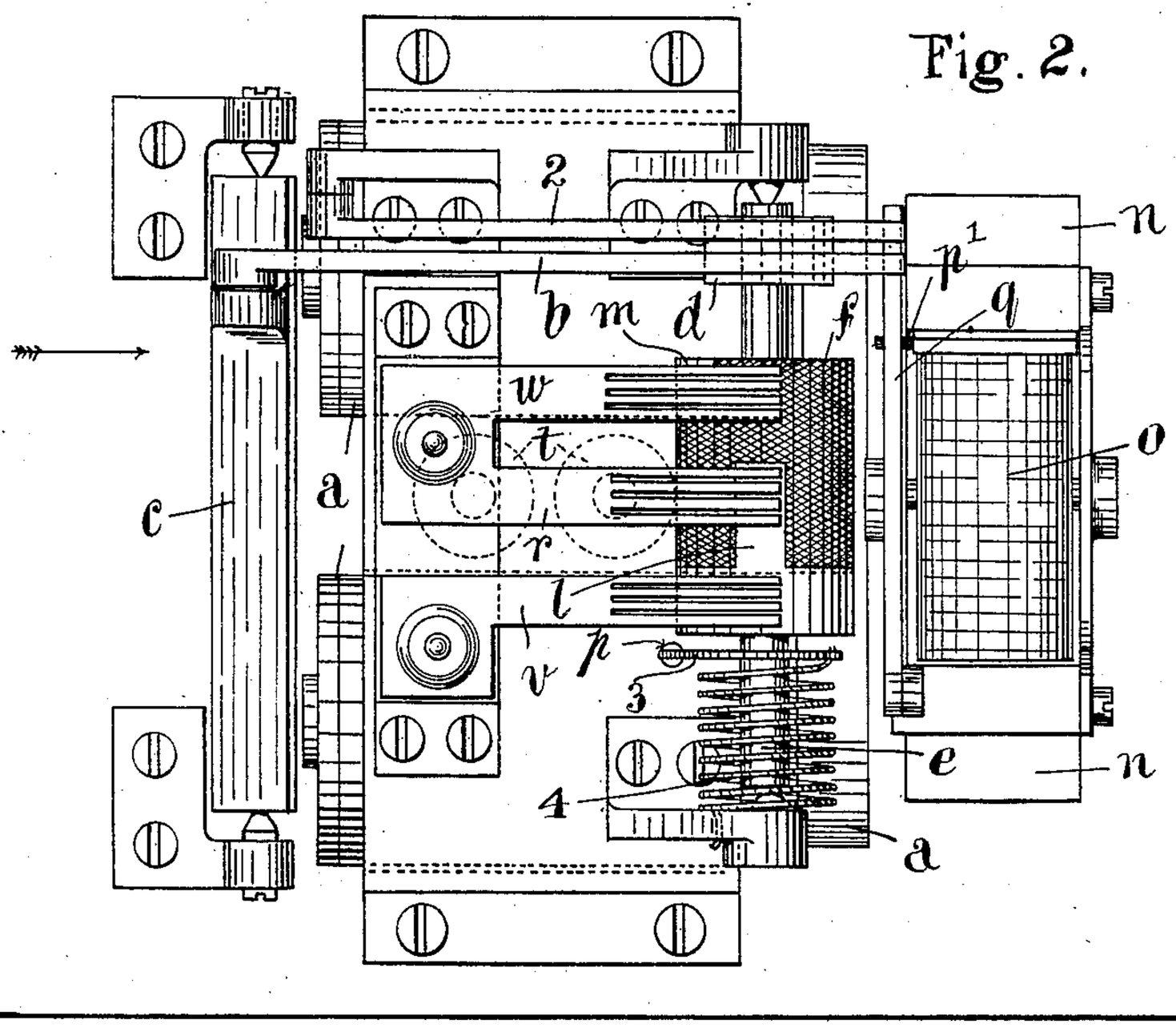


Fig. 2.



Witnesses
Herbert Kuebler
John A. Percival.

Inventor
Harry Bennett Stocks
By his Atty Richards & Co

No. 827,825. PATENTED AUG. 7, 1906.

H. B. STOCKS.

PARTY LINE SYSTEM OF TELEPHONES.

APPLICATION FILED SEPT. 5, 1905.

6 SHEETS—SHEET 2.

Fig. 3.

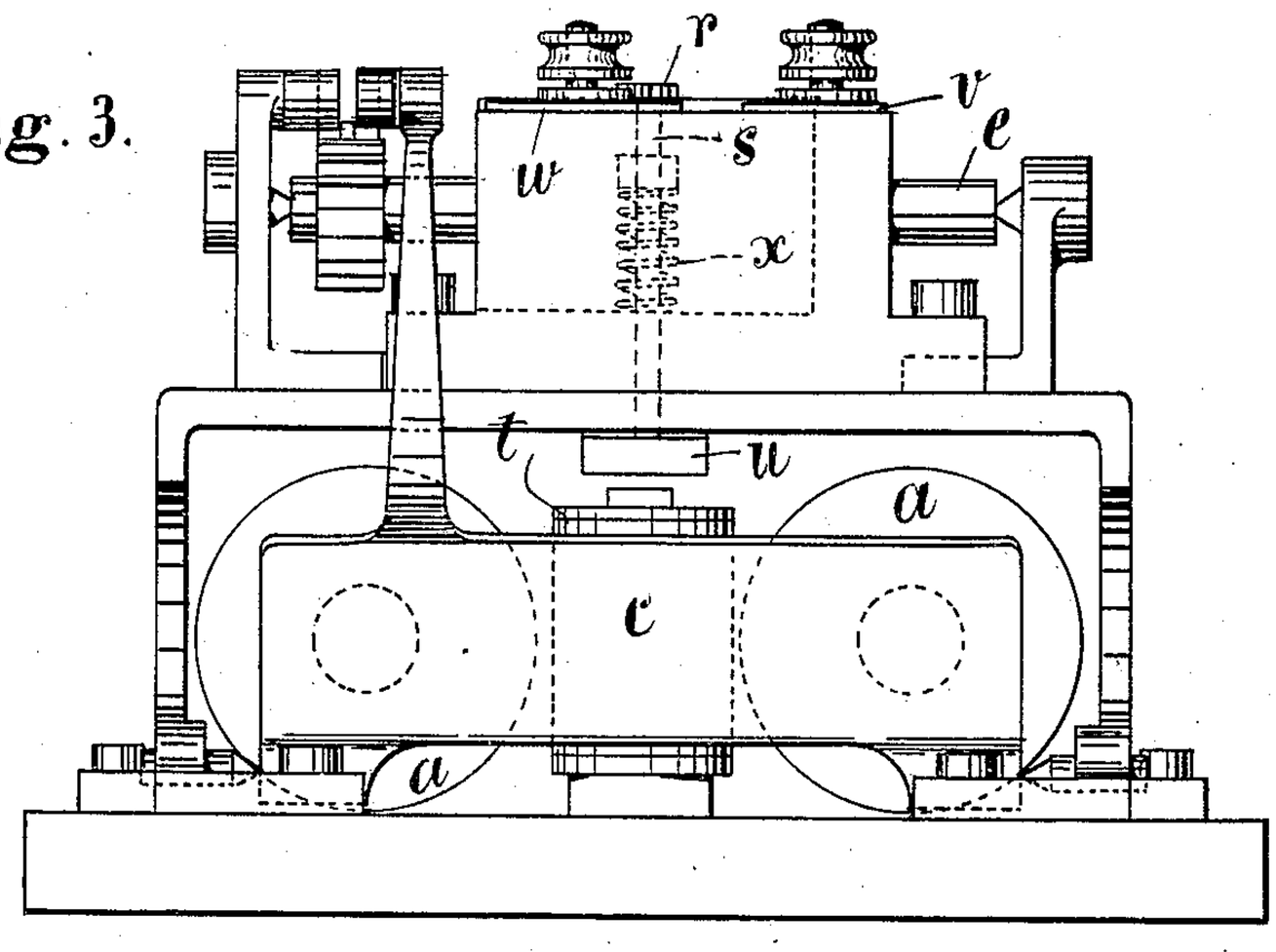
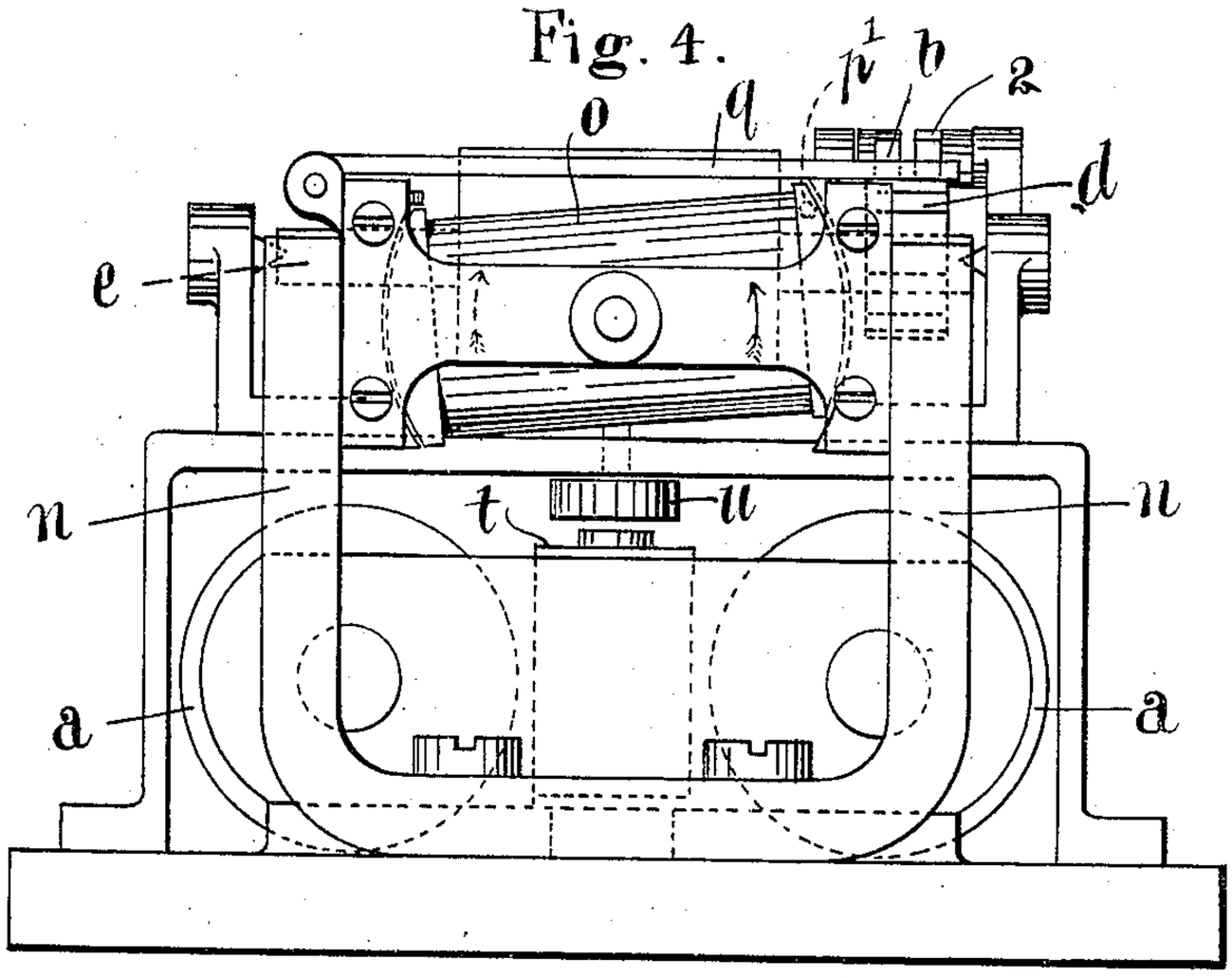


Fig. 4.



Witnesses
Jas. Buchan
John A. Percival.

Inventor
Harry Bennett Stocks
By his atty Richardson

No. 827,825. PATENTED AUG. 7, 1906.

H. B. STOCKS.

PARTY LINE SYSTEM OF TELEPHONES.

APPLICATION FILED SEPT. 5, 1905.

5 SHEETS—SHEET 3.

Fig. 5.

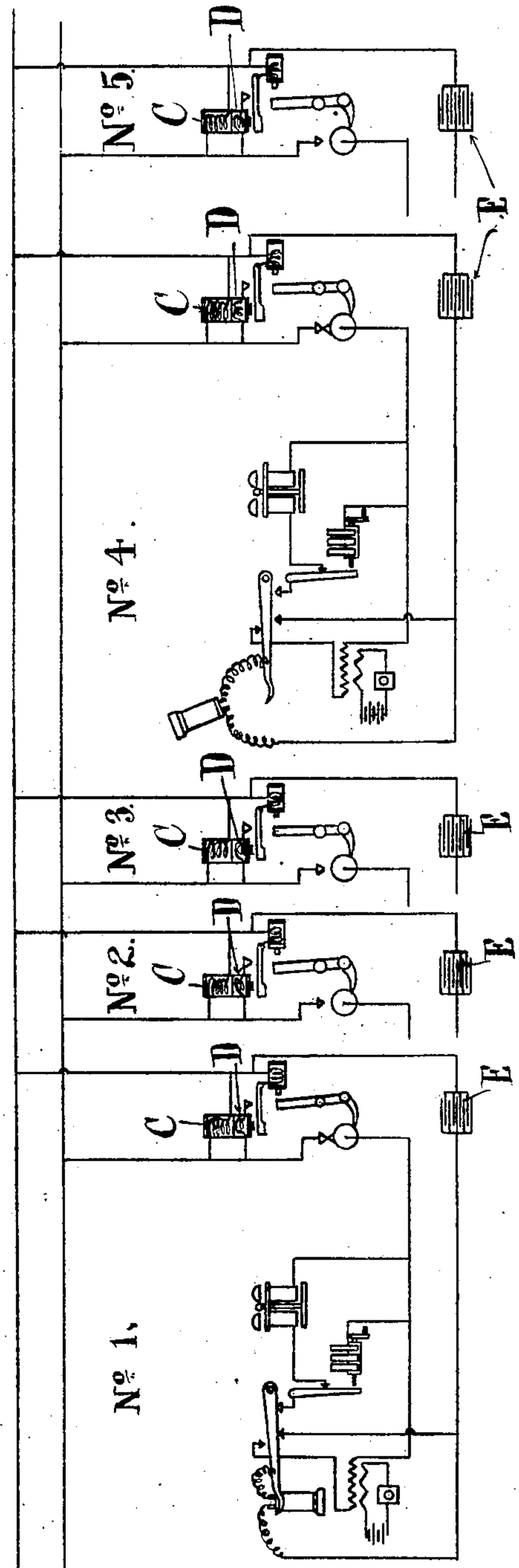


Fig. 7.

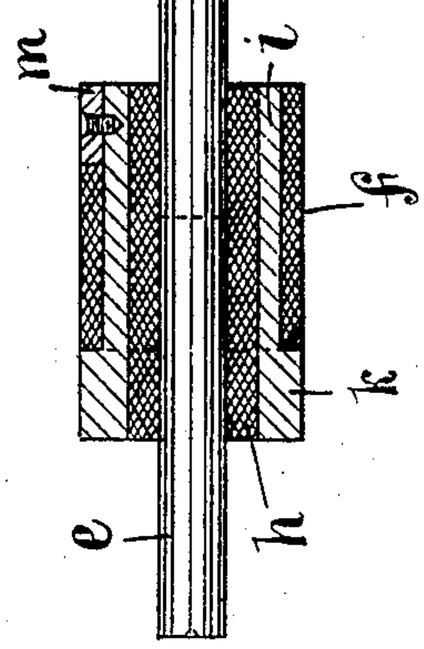
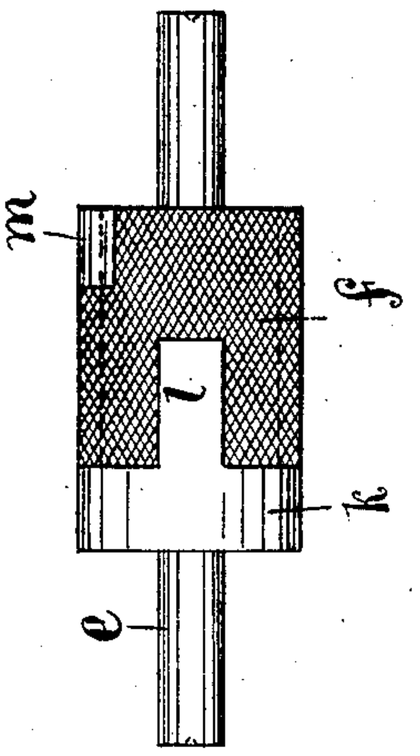
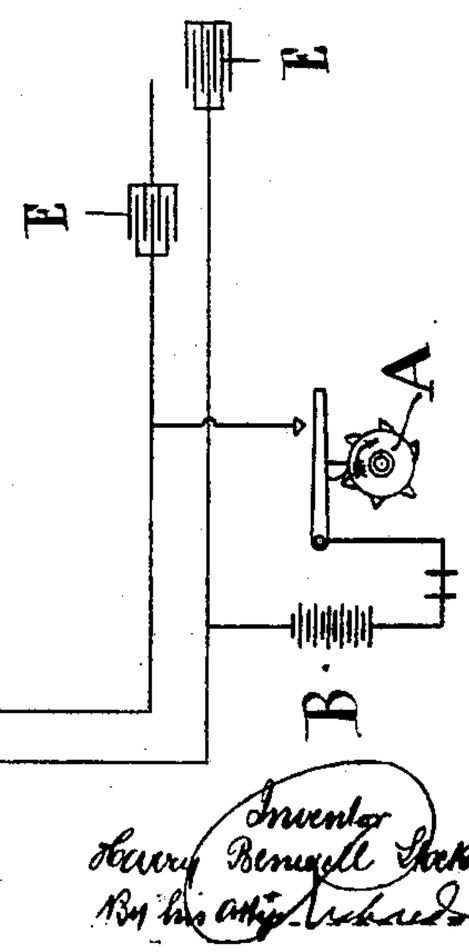


Fig. 6.





Witnesses
Howard Kueny
John A. Percival

Inventor
Harry Benwell Stocks
By his Atty Richard Ashe

No. 827,825. PATENTED AUG. 7, 1906.

H. B. STOCKS.

PARTY LINE SYSTEM OF TELEPHONES.

APPLICATION FILED SEPT. 5, 1905.

5 SHEETS—SHEET 4.

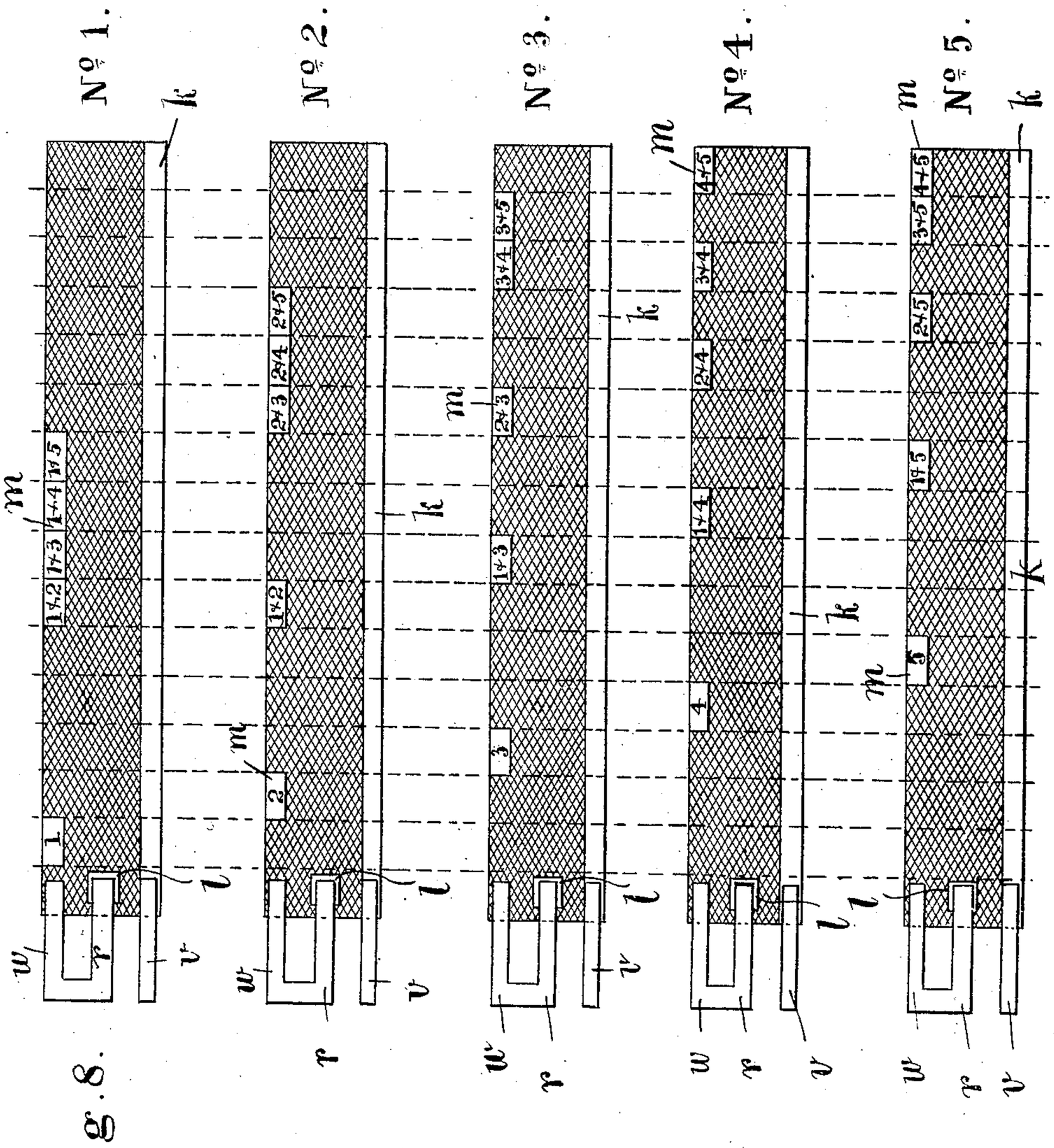


Fig. 8.

Witnesses
H. W. Kuebler
John A. Percival.

Inventor
Harry Benwell Stocks
By his attys Lacey & Lacey

No. 827,825. PATENTED AUG. 7, 1906.

H. B. STOCKS.

PARTY LINE SYSTEM OF TELEPHONES.

APPLICATION FILED SEPT. 5, 1905.

5 SHEETS—SHEET 5.

FIG. 9.

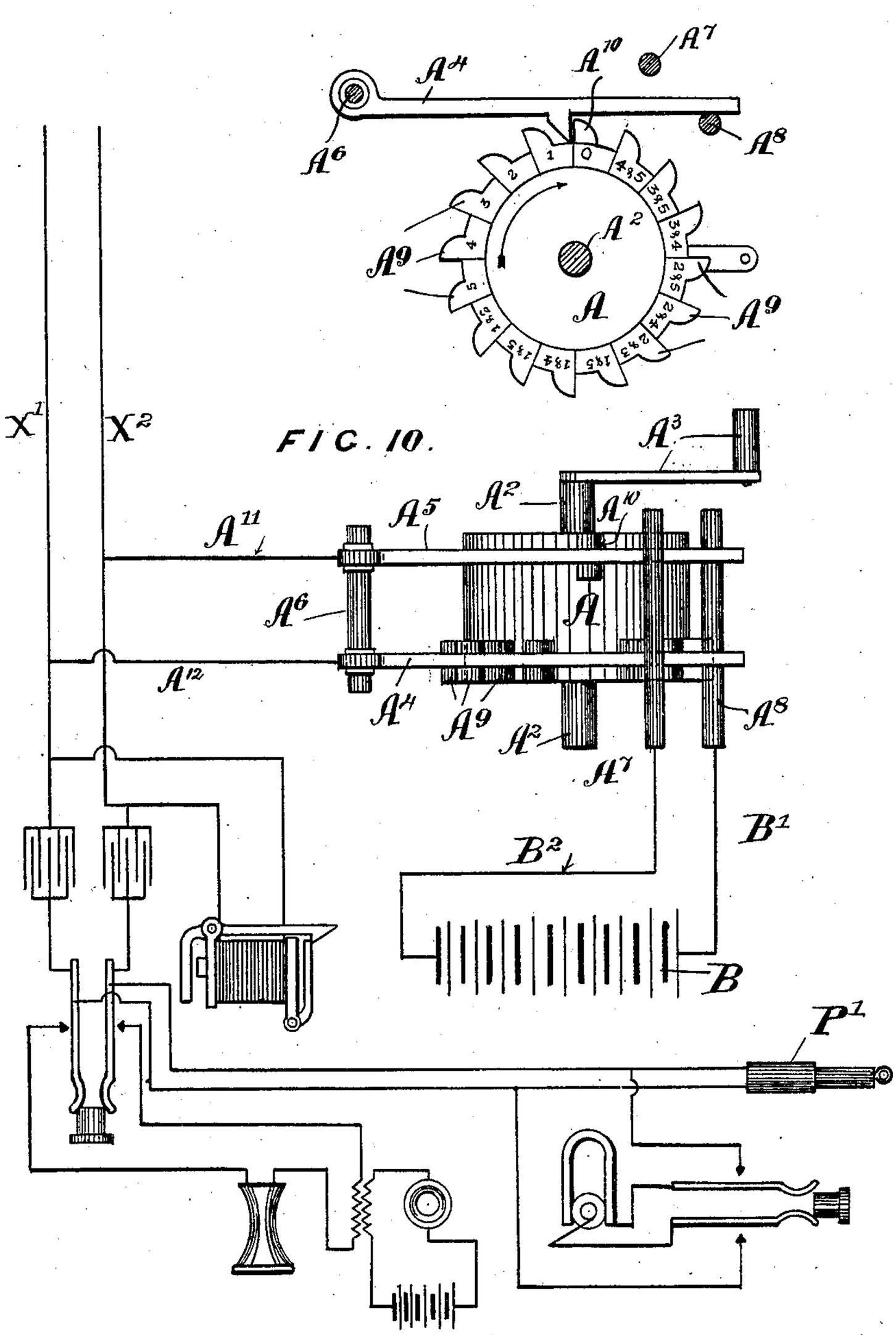


FIG. 10.

Witnesses
W. L. Burke
W. J. Dowson

Inventor
Harry Benwell Stocks
By his attys Richards & Co.

UNITED STATES PATENT OFFICE.

HARRY BENWELL STOCKS, OF MANCHESTER, ENGLAND.

PARTY-LINE SYSTEM OF TELEPHONES.

No. 827,825. Specification of Letters Patent. Patented Aug. 7, 1906.

Application filed September 5, 1905. Serial No. 276,998.

To all whom it may concern:

Be it known that I, HARRY BENWELL STOCKS, engineer, a subject of the King of Great Britain, residing at "Stanton," 124 Barlow Moor road, Chorlton-cum-Hardy, Manchester, in the county of Lancaster, England, have invented new and useful Improvements in or Relating to the Party-Line System of Telephones, of which the following is a specification.

My invention has for its object the provision of switching apparatus at subscribers' instruments (or other suitable position on the line-wires of a party-line system) which shall be capable of operation by the person in charge of the line at the switchboard in the exchange, and at the same time said switching apparatus shall not be under the control, directly or indirectly, of the subscriber unless it is desired that it be so arranged, and at the completion of a call provision is made whereby all switches return to zero position, so that perfect synchronism of the movements of all switch apparatus is assured.

In the accompanying drawings, Figure 1 represents an end elevation of a subscriber's switch apparatus. Fig. 2 is a plan view of same. Fig. 3 is a side elevation looking in the direction of the arrow, Fig. 2. Fig. 4 is a side elevation of the switch from the opposite side. Fig. 5 is a diagram of the circuits. Fig. 6 is a separate view of the switch-drum. Fig. 7 is a sectional elevation thereof. Fig. 8 is a view in flat projection of the five switch-drums, showing all the contacts on such drums, it being assumed that five subscribers are on the party-line. Fig. 9 is an elevation of the operator's switch. Fig. 10 is a plan thereof and shows the connections to the party-line X′ and X².

In carrying my invention into effect I provide that each switch apparatus, hereinafter called the "switch," and which is illustrated in Figs. 1 to 4, shall consist of an electromagnet *a* or other apparatus capable of working by the passage of an electric current, which electromagnet by means of a pawl *b*, connected to an armature *c*, intermittently rotates a ratchet-wheel *d*, secured to the spindle *e* of a drum *f*, a tooth at a time at each vibration of the armature. A locking-detent 2 serves to lock the ratchet-wheel. The drum *f* thus intermittently rotated carries the necessary contacts whereby one or more subscribers may be arranged in talking-circuit.

In Fig. 8 is shown in flat projection the drums and contacts thereon for five subscribers of a party-line. This drum is so designed that with reference to the other parts of the mechanism, as hereinafter described, only two brushes are necessary to complete the circuits of the telephone required that talking may be carried on over the line.

The construction of the drum is shown particularly in Figs. 6 and 7. On a central steel spindle *e* is mounted a bush *h*, of vulcanite or other insulating material. On this is placed a sleeve *i*, of brass, having an enlarged end *k* with an extension *l*, which extension forms the zero position for all the switch-drums, as will be seen from the diagram Fig. 8. The contacts *m* are secured to and in contact with the sleeve of brass *i* and the parts filled up with vulcanite to complete the circular periphery of the drum, as shown in Fig. 7. On the spindle *e* of the drum is a disk 3, to which is secured one end of a coiled spring 4, the other end being secured to a fixed part of the switch, so that as the drum is rotated by the ratchet-and-pawl mechanism the spring is wound up.

The operator at the exchange is provided with a suitable operator's switch A, Fig. 5, whereby a powerful battery B can be "cut in" to line, such switch having an indicator to show the number of impulses that have been given to the switch-magnets, and thereby indicating the number of the subscriber on the line who is in talking-circuit. The line apparatus may be described as follows: All subscribers are arranged in "parallel," as shown in Fig. 5, on a metallic return for preference. In parallel working I provide a suitable high-inductance relay C of the necessary resistance across the loop or branch from the main-line wires—in other words, in shunt across the line—and arranged at each subscriber's instrument or other suitable position on the loop branch or line, as the case may be. This relay is compound wound for reasons that will be apparent hereinafter. On this relay C being closed by the current sent through it by the operator at the exchange (hereinafter called the "switching-current") a second path is open for the passage of the current—viz., through the switch-magnet D, which is also in shunt across the line. This switch-magnet, being of comparatively low resistance and inductance, is normally cut out of the line by the relay C of high inductance when the relay is

open—*i. e.*, during the time that conversation is proceeding on the line after the necessary impulses have been sent over it. The fine-wire coil C in itself would be insufficient to maintain the closed contact made by the armature of the relay. It is therefore necessary to assist it by means of the coil D. The fine-wire coil C of the relay is for the purpose of attracting the armature of the relay, thus closing another circuit of low resistance by means of which the impulse-currents may flow through the electromagnet *a*, operating the switch-drum *f*. This low-resistance circuit will short-circuit the higher resistance of the fine coil C. This would tend to weaken the magnet-core of C and D if the coil D were not included in the low-resistance circuit. It will therefore be seen that during the time that conversation is being carried on the talking-current has a clear path to line, as the high-resistance relays C are in shunt across the line, and therefore can be neglected, owing to their high inductance. This inductance may be increased by "choking-coils" in series with the relays C, if necessary, in order that the comparatively slow alternations of the magneto bell-currents may be properly dealt with. These choking-coils should be of the lowest possible resistance compatible with their construction for highest impedance, that they may not waste the direct current used to operate the switch-magnets and relays.

The switch itself is provided with suitable magnets for the purpose hereinafter described. First, magnets *a* are provided, as already stated, to operate the switch-drum *f* by ratchet-and-pawl mechanism by means of the switching-current; secondly, in series or in parallel with these magnets I provide a further magnet *n*, which is of suitable construction, and when the zero position is again reached by the operator's switch after the termination of a call the switch is so arranged that a reversal of the direction of the switching-current is obtained, and as the second magnet *n* is of the polarized type this reversal of switching-current every time zero is reached causes the armature *o* to move in the opposite direction or in the direction shown by the arrow in full lines, Fig. 4. This being understood, suitable means are provided whereby this reversal of direction of the armature is caused to raise the pawl and locking-detent from the ratchets of the switch-barrel and allow the switch-barrel to be turned backward to the zero position and held there by a suitable stop *b* by the coiled spring or other means. To effect this, the armature *o* carries a pin *b'*, Fig. 2, disposed below a pivoted lever *q*, which is thus lifted by the armature, the lever *q* raising the pawl *b* and locking-detent 2 out of engagement with the ratchet-wheel *d*. By this means all switches are brought back to zero position simultaneously, and it will be seen, therefore, that should any one of the switches have missed an impulse, and thereby be out of synchronism with its fellow switches, the reversal of the direction of the switching-current on zero position of operator's switch will bring all switches back into their correct position in readiness for the next call, and thereby restore the lost synchronism which may have taken place.

The telephone instruments are completely isolated from the powerful switching-current by connecting up through the medium of condensers E, the condensers being no obstacle to the bell and speaking currents, but being an insurmountable barrier to the continuous current from the switching-battery.

In the arrangement shown in the drawings zero breaks all ringing and talking circuits, the zero brush *r* being normally raised by a spring-actuated plunger *s* clear of zero contact *l* on the drum, as shown in Fig. 1, the other brushes *v w* being always in contact with the drum.

When the brush *r* is lowered into contact with zero on the drum by a subscriber, ringing and speaking can take place with the exchange operator without causing any of the other bells in the circuit to be rung. To effect this, the subscriber presses a push-button, causing the zero brush to fall onto the switch-drum by means of a suitable magnet *t*, fitted in the switch-box, operated by the current from the transmitter-battery, or auxiliary cells may be provided for this purpose. The armature *u* is secured to the end of the plunger *s* and is lowered by the electromagnet *t* against the action of the spring *x*. The instrument is thus cut into line, the subscriber releasing said push-button after obtaining number required, circuit then being through the brushes *v w*, third or zero brush *r* being raised. Should, however, the line be already engaged, the switch-drum is so arranged that a subscriber calling under these circumstances will not be able to cut in, as it will be apparent on an inspection of Fig. 8 that the zero contact *l* will have been removed from below the zero brush.

The contacts *k m* are so arranged on the switch-drums that on rotation simultaneously by the switching-current suitable connections are made that subscribers speak on outside lines or are placed in intercommunication with each other without a multiplicity of brushes or compound circuits. For instance, and referring to Fig. 5, suppose No. 4 should be asking exchange for a number outside the party-line. The operator will give four impulses, as explained, which will rotate all the drums in the series four intermittent movements corresponding in distance to the dotted lines shown in Fig. 8. Zero contacts will then be all removed from beneath zero brushes *r*, so that no other sub-

scriber can cut in. Brushes *v w* are then on contacts *k m*, (marked 4 on No. 4 drum,) all the other drums being cut out by the insulating material. No. 4 can then communicate with outside subscriber. On the other hand, should No. 4 ask for No. 1, the operator gives eight impulses, which, as will be seen from the diagram, Fig. 8, connects 1 to 4. In Fig. 5, 1 to 4 are shown connected, and it will be understood that in this figure parts of the apparatus—such as the receiver, bells, and the like—are not shown with respect to subscribers 2, 3, and 5 for lack of space. Six impulses connect 1 and 2, ten impulses connect 2 and 3, and so on, a maximum number of fifteen impulses connecting 4 and 5. It will be understood that the number of subscribers may be varied, five having been instanced as a convenient number.

If desired, the zero brush *r* may always be in contact with the drum *f*, although this has the disadvantage of causing all bells to ring in the circuit. In such case it would not be necessary to provide means for raising and lowering the zero brush *r*.

The switching performed is an absolute "cut-out" and not a short-circuiting of the telephones not required.

Switch-magnets may be of the usual form, or more powerful effects may be obtained by using permanent magnets of the magneto-dynamo type, as shown in the drawings, the armature being suitably wound and of drum or ring or multipolar type, so as to be in balance against the pull of the permanent magnets when no switching-current is passing, the reversal of current causing a reversal of movement of the armature on zero position, as required and hereinbefore described.

A stop *y* is provided to resist any tendency of the armature *o* to rotate in the direction of the dotted arrow.

The operator's switching apparatus consists of a vulcanite cylinder A, mounted on a spindle A^2, which is rotated by the crank-handle A^3. Projecting from the periphery of the said cylinder A are a number of teeth A^9 and A^{10} of the form shown in the drawings. All of the said teeth with the exception of A^{10} are situated on one side of the periphery, A^{10} being placed at the other side of the periphery, as will be seen from the plan view Fig. 10. The spaces between the teeth A^9 are all equal except the space between that tooth marked 1 and the teeth marked 4 and 5. This latter space is just twice as wide as the space between the remainder of the teeth on that end of the cylinder. The tooth A^{10}, situate at the other end of the cylinder, is opposite the gap between the teeth marked 1 and 4 and 5. Two levers A^4 and A^5 are freely mounted on a common spindle A^6, and both are insulated therefrom. One of the levers A^4 is suspended over the end of the cylinder A and has a projecting tooth which engages with those marked A^9. The other lever A^5 is placed so that the tooth on its under side may engage the tooth A^{10} on the cylinder. If the cylinder is rotated in the direction of the arrow, the lever A^4 will be raised as each tooth A^9 passes under it. The lever A^5 will only be operated once in each revolution of the cylinder—that is, when the tooth A^{10} passes under it. Both levers A^4 and A^5 are of metal and are normally supported at one end by resting on a bar A^8; but when the levers are raised they come in contact with another bar A^7. The bars A^7 and A^8 are respectively coupled to the positive and negative terminals of a powerful battery of voltaic cells or some other source of electric current by means of the wires B^2 and B′. It will be seen that when the lever A^4 is raised into contact with A^7 a current impulse will be transmitted to the line-wires in one direction, and if the lever A^5 is raised into contact with A^7 then an impulse will be sent along the line in the reverse direction, the reversal of the current releasing the drum *f*, as described, so that the spring 4 will return it to zero. The arrangement is such that both levers cannot be raised at the same time, one always remaining in contact with A^8. The principle of this reversing-switch is well known in telegraphy. The only novel part is the means by which one lever A^4 is arranged to lift many times in succession before the lever A^5 is raised. The remaining portion of Fig. 10 shows the usual operator's indicating, receiving, and transmitting apparatus, the plug P′ being used to put an outside subscriber onto the party-line.

I declare that what I claim is—

1. In a party-line telephone system, the switch-box for subscribers' instruments, consisting of an electromagnet or the like, an armature influenced by such electromagnet, a drum having contacts thereon, a ratchet-wheel secured to such drum, a pawl actuated by the armature to rotate the ratchet-wheel and drum by impulses through the electromagnet, a spring coiled by the rotation of the drum, a brush for zero position, a spring-actuated plunger for normally holding the brush for zero position out of contact with the zero contact on the drum, an armature on the plunger and an electromagnet to attract the armature and bring the brush on the zero contact, brushes for speaking contacts on the drum, and a magnet of the polarized type, the pawl and a locking-detent from the ratchet-wheel on a reversal of current being sent through the polarized magnet the springs returning all the drums in the party-line system to zero, substantially as described.

2. In combination in a switch for party-line telephones, the switch drum or barrel consisting of a central steel or other metallic spindle, an insulating-bush on such spindle, a sleeve of conducting material on such bush, a

continuous contact *k* with projection for zero-contact, and contacts *m* secured to the sleeve, and a compound brush *r w* and brush *v* substantially as described.

3. A switch drum or barrel consisting of a central steel or other metallic spindle, an insulating-bush *h* on such spindle a sleeve *i* of conducting material on such insulating-bush, a continuous contact *k* with projection for zero-contact, and contacts *m* secured to the sleeve *i*, substantially as described.

4. In a party-line telephone system in each subscriber's set the combination of a shunt-circuit including the fine-wire coil of a compound-wound relay with a parallel circuit including the coil of thick wire in the compound-wound relay a selection switch-drum and an electromagnet for operating the selection switch-drum, the said parallel circuit being normally open but closed by impulses of current through the fine-wire windings of the compound-wound relay, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HARRY BENWELL STOCKS.

Witnesses:

JOSHUA ENPRIDE,

ALFRED YATES.