

(No Model.)

A. MUIRHEAD.  
Duplex and Multiplex Telegraph.  
No. 230,802. Patented Aug. 3, 1880.

Fig. 1.

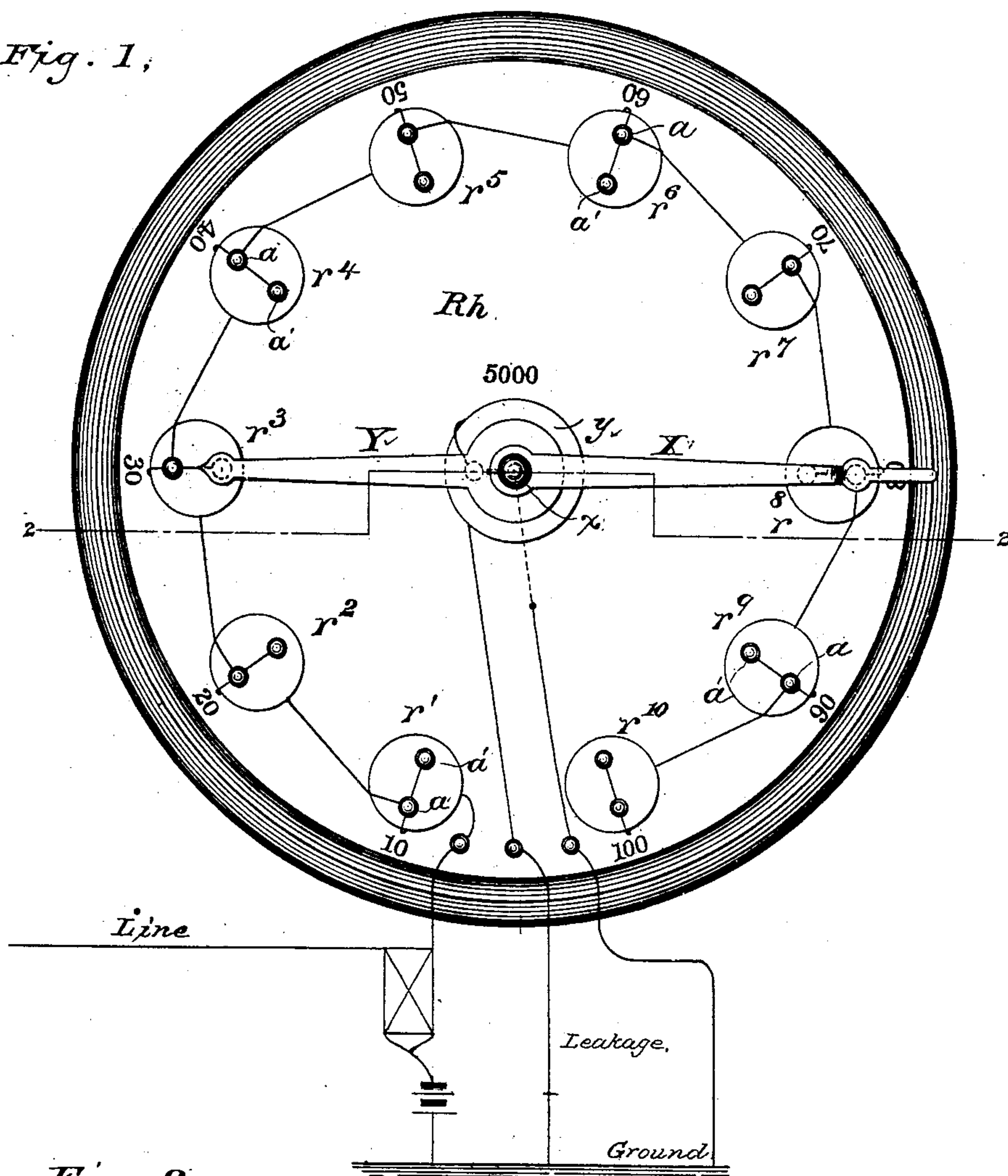
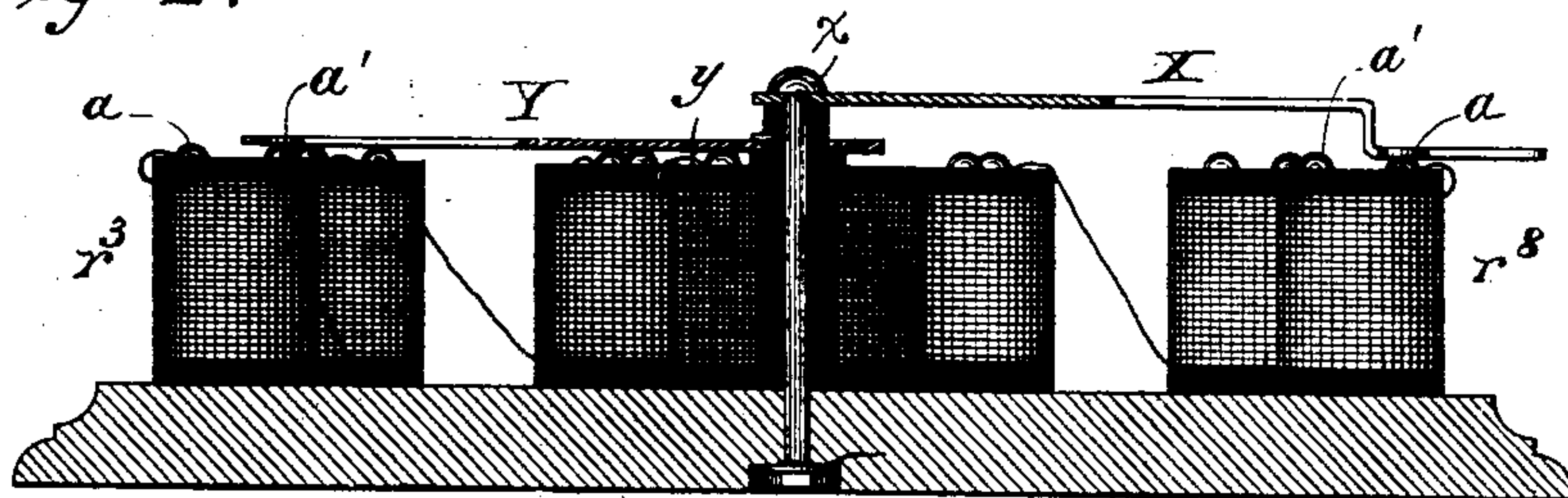


Fig 2.



WITNESSES

Wm A. Shinkle.  
Geo W. Buck.

INVENTOR

Alexander Muirhead.

By his Attorneys.

Baldwin, Hopkins & Peyton



# UNITED STATES PATENT OFFICE.

ALEXANDER MUIRHEAD, OF OAKWOOD, FARQUHAR ROAD, UPPER  
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## DUPLEX AND MULTIPLEX TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 230,802, dated August 3, 1880.

Application filed March 24, 1880. (No model.)

*To all whom it may concern:*

Be it known that I, ALEXANDER MUIRHEAD, a subject of the Queen of Great Britain, doing business at 29 Regency Street, Westminster, England, and resident at Oakwood, Farquhar Road, Upper Norwood, London, England, have invented certain new and useful Improvements in Duplex and Multiplex Telegraphs, of which the following is a specification.

The object of my invention is an improvement in the mode or manner of regulating or adjusting the artificial lines or compensating-circuits in systems of duplex and multiplex telegraphy, especially those used on aerial and underground lines.

It consists in introducing in the artificial line a leakage-circuit of a fixed resistance and varying its position with regard to the resistance of the artificial line.

In all successful systems of multiplex telegraphy in which a differential arrangement of the transmitting and the receiving apparatus is employed there is required for the accurate working of the system a circuit having exactly the same electrical resistance and capacity of the real line. Such circuits are called "artificial lines" or "compensating-circuits."

Hitherto, in order to compensate further for the variations of insulation of the real line, it has been the practice to produce a similar effect in the artificial-line circuit by varying both its resistance and capacity, two operations which cause great delay in the working of the system. In my invention I compensate more quickly for these variations of insulations of the real line by simply inserting a leakage-circuit in the artificial line and varying its position until the resultant insulation-resistance of the artificial line is the same as the insulation-resistance of the real line.

The leakage-circuit is of a resistance determined by trials for all to give the best results. From experience I find five thousand units resistance a very convenient amount to have in this leakage-circuit.

In the drawings, which represent one mode of carrying out my invention, Figure 1 is a

plan view of a rheostat and adjustable leakage-circuit, and Fig 2 a section through the line 2 2 of Fig. 1.

Rh is a rheostat, consisting of a series of coils or resistances,  $r^1 r^2 r^3$ , &c., to  $r^{10}$ . These I prefer to make of Muirhead's inductive resistance, as described in United States Letters Patent No. 208,665, of October 1, 1878, to John Muirhead, Jr., for improvement in condensing-resistance, for electric telegraphs.

X is the adjustable arm of the rheostat, pivoted on the axis  $x$ , with which it is in electric communication. Y is another arm working independently on the axis  $x$ , but insulated therefrom, and also from the arm X.

$y$  is the leakage-circuit, made in this instance of ordinary German-silver or platinum-silver wire, one end of which is attached to the movable arm Y, and the other to earth.

$a a'$  are contact-points in the resistance-coils  $r^1 r^2 r^3$ , &c., making contact, respectively, with the arm X of the rheostat and the arm Y of the leakage-circuit. The arm X is shown bent and making contact with the outer contact-point  $a$ , so as to be completely insulated at all points from the leakage-circuit and its arm Y.

All variations in the insulation of the real line can be compensated for by simply varying the point of application of the leakage-circuit  $y$ —that is to say, supposing the resistance of the rheostat to be  $r^5$ , corresponding to the resistance of the real line, all variations in the insulation can be compensated for by applying the leakage-circuit at any point from  $r^1$  to  $r^5$ . In the drawings the leakage-circuit is represented as at  $r^3$ .

What I claim as new, and desire to secure by Letters Patent, is—

1. The hereinbefore-described method of adjusting artificial lines or compensating-circuits in systems of duplex and multiplex telegraphy, which consists in inserting an adjustable leakage-circuit in the artificial line and varying its position, substantially as and for the purpose described.

2. The combination of the artificial line and the adjustable leakage-circuit, substantially as described.

3. The combination of the leakage-circuit,

consisting of the insulated and adjustable arm  
and its resistance, with a rheostat consisting  
of a series of resistances and an adjustable  
rheostat-arm turning on the same axis as the  
5 leakage-circuit, but insulated therefrom, sub-  
stantially as described.

4. The leakage-circuit consisting of the com-  
bination of the insulated and adjustable arm  
and its resistance, the whole operating substan-  
10 tially as described.

In testimony whereof I have hereunto sub-  
scribed my name this 27th day of February,  
1880.

ALEXANDER MUIRHEAD.

Witnesses:

CHAS. EDGAR MILLS,  
WILLIAM D. WARD.