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ELECTRICAL TRANSMITTING SYSTEM

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2 Sheets-Sheet 1

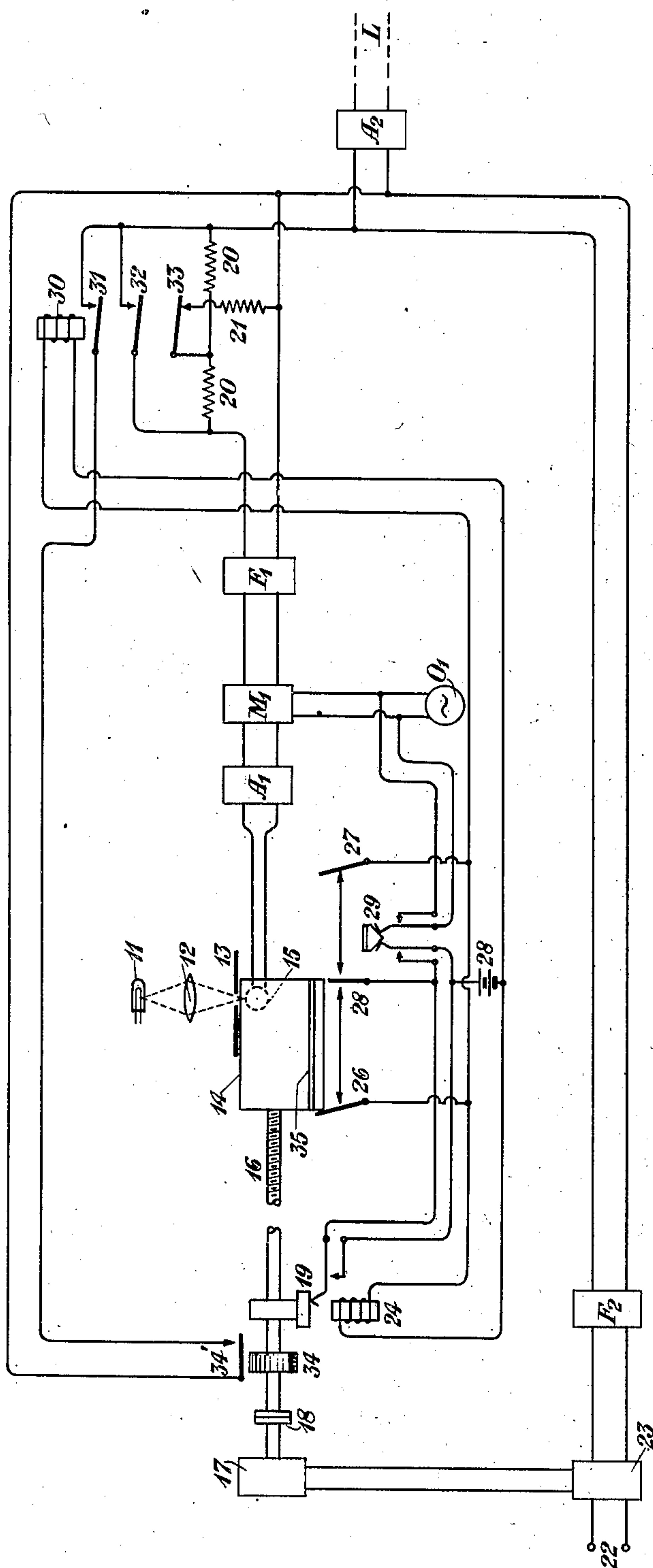


Fig. 1

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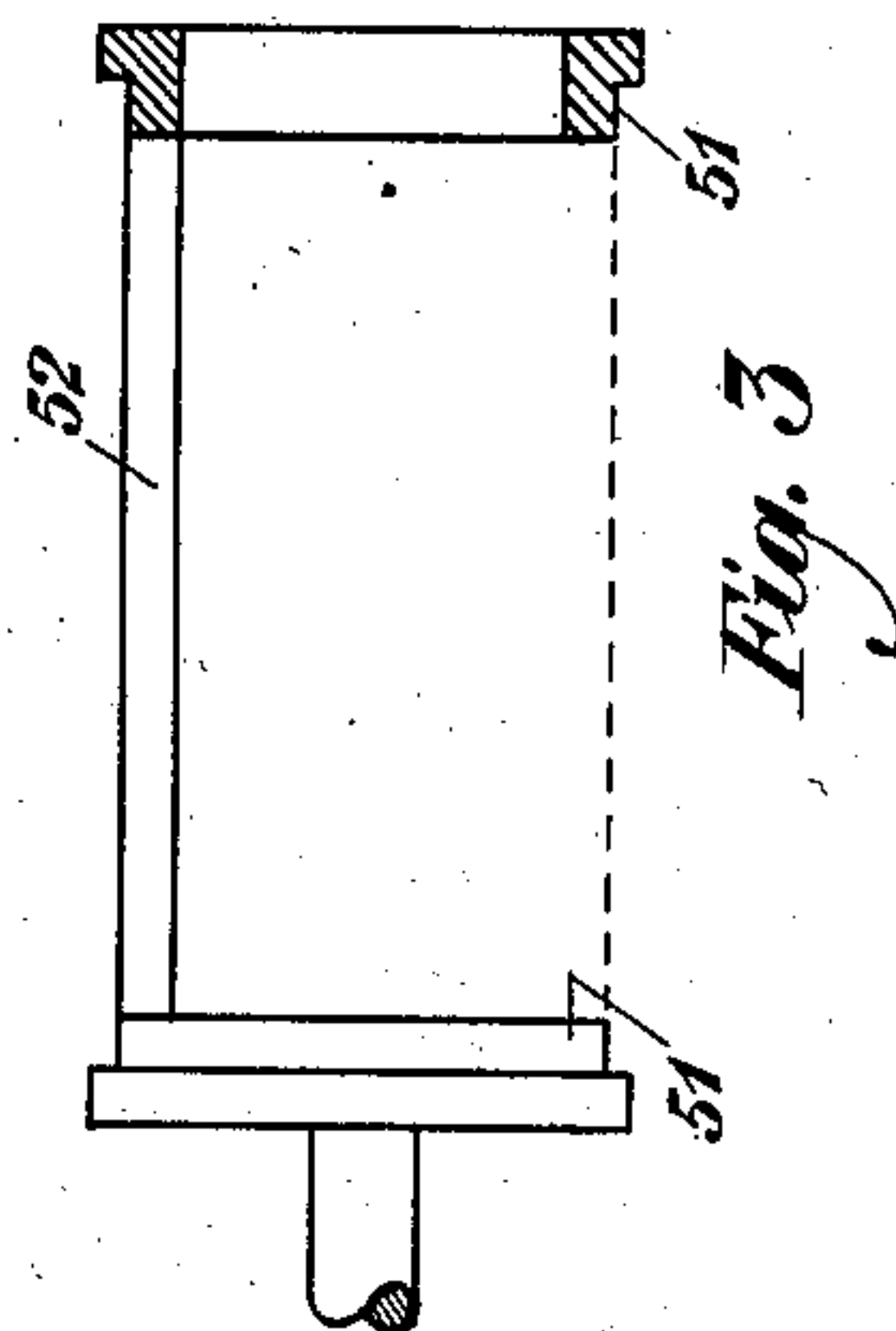
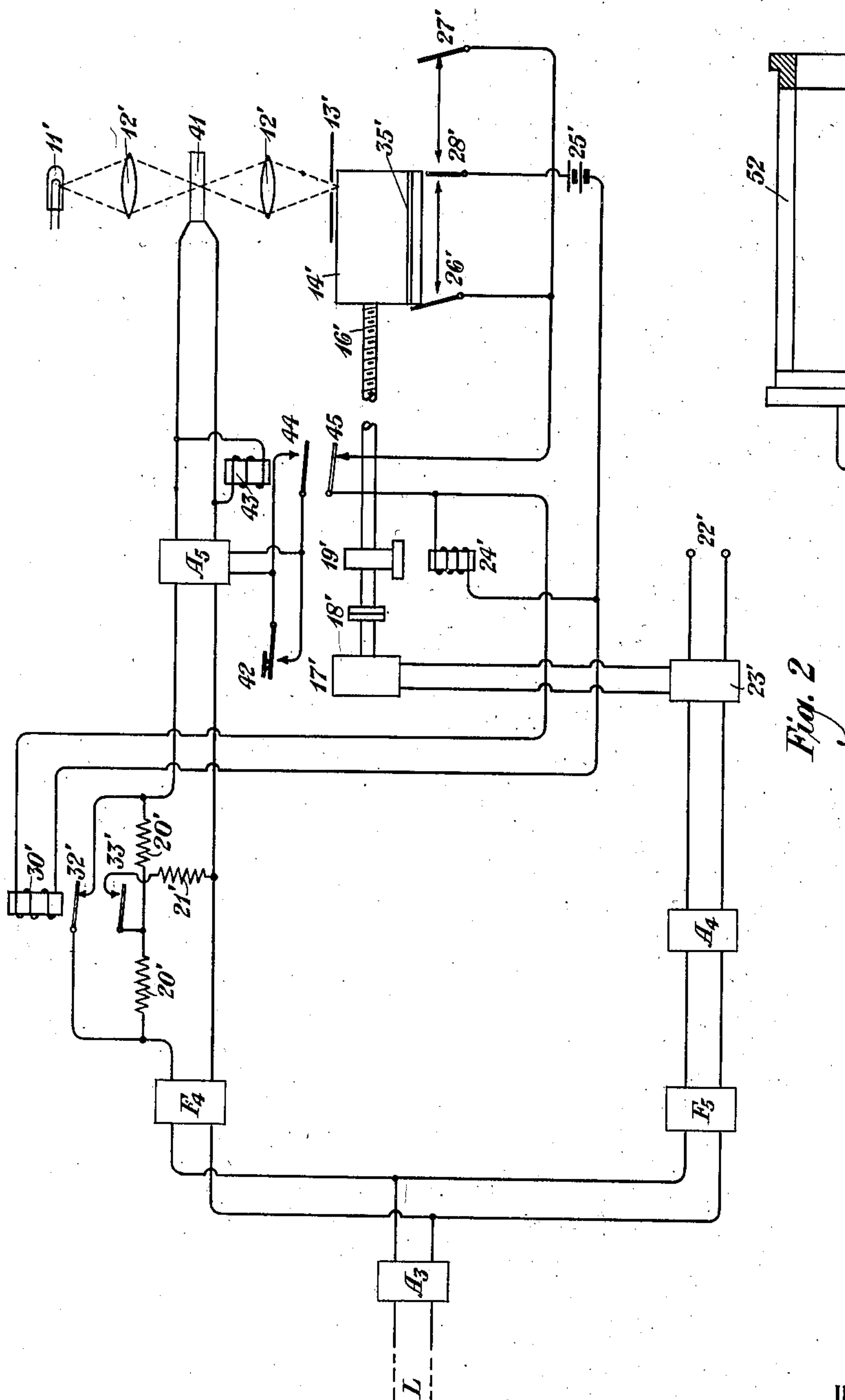
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2 Sheets-Sheet 2



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ELECTRICAL TRANSMITTING SYSTEM.

Application filed May 1, 1925. Serial No. 27,253.

An object of my invention is to provide a new and improved system for electrical transmission over a line with provision for guarding against inductive interference to other lines when the input electromotive force at the sending end of the system becomes excessive. Another object of my invention is to provide for cutting down the current on the line but keeping the overall transmission equivalent unchanged when occasion arises for applying excessive electromotive forces at the transmitting end. Still another object of my invention is to provide for cutting down the current on the line in a picture transmitting system when the currents would otherwise become excessive on the line, as when making adjustments etc., and at the same time keeping the transmission equivalent value of the entire system unchanged. These and various other objects of my invention will become apparent on consideration of a limited number of specific examples of practice according to the invention, which I have chosen to illustrate and describe in this specification taken with the accompanying drawings. It will be understood that the following description refers to these particular examples of the invention, and that the invention will be defined in the appended claims.

Referring to the drawings, Figure 1 is a diagram of the transmitting end of a picture transmitting system embodying my invention, Fig. 2 is a diagram of the corresponding receiving end, and Fig. 3 is a sectional elevation of a modified skeleton transmitting film holder.

The cylindrical glass drum 14 at the sending end shown in Fig. 1 has a semi-transparent picture film wrapped about it. This drum is rotated on its axis and meanwhile traversed slowly along its axis by virtue of the engagement of the screw-threaded shaft 16 with a suitable support. Inside the drum 14 is a photoelectric cell 15, supported opposite the opening in the screen 13. Light from the source 11 is focused by the lens 12 on the spot of the film 14 underlying the opening in the screen 13, and this light passes through the film in degree corresponding to its transparency at the spot involved, and this light entering the photoelectric cell 15 determines the magnitude of

the electric current on the input side of the amplifier A_1 . The output current from the amplifier A_1 , of amplitude determined by the degree of transparency of the picture film, goes to the modulator M_1 and modulates the current from the oscillator O_1 . The modulated current from M_1 goes through a filter F_1 and through (or past) a network 20, 21, 20 to the amplifier A_2 and the line L.

Direct current is applied at 22 to apparatus 23, comprising a periodic interrupter of definite rate from which periodic current goes to drive the synchronous motor 17, and also periodic current goes through the filter F_2 to the amplifier A_2 and the line L. F_1 is a high pass filter and F_2 is a low pass filter, and the picture transmitting current and the synchronizing current are respectively of relatively high frequency and low frequency.

The motor 17 drives the drum 14 through a friction coupling 18, and 19 is a clutch that locks the drum 14 against movement except when it is disengaged by energization of the magnet 24. The cam 34 closes the switch 34' just as the space between the ends of the film at 35 passes under the opening in the screen 13.

At the receiving end shown in Fig. 2, the currents coming in on the line L are amplified by amplifier A_3 and separated according to their frequency by the high pass filter F_4 and the low pass filter F_5 . The high frequency picture transmitting currents go through (or past) the network 20'—21'—20' and through the amplifier A_5 to light valve 41.

The low frequency currents through the filter F_5 and amplifier-detector A_4 go to apparatus 23' which is energized from a direct current source connected at 22' and delivers periodic current to the synchronous motor 17', driving it in step with the motor 17 at the sending end. The motor 17' drives the drum 14' through a friction coupling 18', and the clutch 19' locks the drum 14' against movement except when released by the energization of the magnet 24'.

Light from the source 11' is directed by the lenses 12' through the light valve 41 and the opening in the screen 13' on the underlying spot of a sensitive film wrapped on the drum 14'.

Other structural features of the system

will become apparent on consideration of the following description of the mode of operation, taken in connection with the drawings. Assume that a positive film, corresponding to the picture to be transmitted, has been placed around the drum 14 with its ends spaced slightly apart as at 35. Also at the receiving end on the drum 14' there has been placed a sensitive film with its edges at the same angular position 35', as determined by routine procedure. Both drums, 14 and 14', are at one extreme of their travel, holding open the switches 26 and 26'. Further to prepare for the transmission of the picture as intended, the operator at the receiving end presses down momentarily on the key 42. At this time the oscillator O_1 at the sending end is sending over the line a current of the pure carrier frequency which is received at the amplifier A_5 and goes to the light valve 41, holding it at a constant adjustment of opening. The closure of the key 42 adjusts the amplifier A_5 so that it functions as a detector, and the detected output current acting on the relay 43 closes the contacts 44 and holds the detector adjustment after the key 42 is released. The energization of the magnet 43 also opens at 45 the circuit of the battery 25' which is also already open at 28'. The receiving operator now throws the switch 28' to the right and his system is ready for the intended operation.

The operator at the transmitting end, shown in Fig. 1, now throws his switch 28 to the right and then he momentarily presses button 29. This latter operation puts a shunt across the oscillator O_1 and interrupts the flow of carrier current over the line to the amplifier A_5 at the receiving end. Thereupon the relay 43 releases, putting an end to the detector adjustment of the amplifier A_5 so that it thereafter functions as an amplifier, and also closing at 45 the circuit of the battery 25'. It results that the magnets 24' and 30' are energized. 24' disengages the clutch 19', permitting the drum 14' to start in motion. The network at the receiving end, 20'—21'—20' has been cut out until the magnet 30' is energized, and it is then cut into the circuit.

Simultaneously at the transmitting end the closure of the button 29 closes the circuit of the battery 25 on the magnets 24 and 30. The energization of magnet 24 disengages clutch 19, permitting the drum 14 to start in motion. The network 20, 21, 20 has been cut in on the line until the energization of the magnet 30 cuts it out. The system is now operating normally.

Antecedent to the start of operation that has just been described, it is necessary to adjust the apparatus at the transmitting and receiving ends, particularly with reference to getting the right degree of light exposure

at the receiving end. The adjustments referred to are dependent in large measure on the character of the film used for transmitting, and hence may need to be made before each transmission. The transmitting currents are attenuated as they go over the line, and the degree of attenuation may vary from time to time, as for example in the case of an open wire line the attenuation may be greater in wet weather than in dry weather. These considerations suggest the importance of the preliminary adjustments before the actual picture transmission is started.

In the system as here described transmission is from a positive or negative film at the transmitting end, and the largest currents will be put on the line when the light is the highest in the film, that is, when a spot of relatively high degree of transparency underlies the opening in the screen 13. It will be desirable at such a time to have the intensity of current on the line about as high as will be permissible without causing inductive interference with other transmission lines in the neighborhood, particularly telephone lines. In making the adjustments referred to before starting the transmission, it might occasionally happen that even stronger currents than this permissible maximum would occasionally be put on the line and the networks 20—21—20 at the sending end and 20'—21'—20' at the receiving end are arranged to guard against this.

When the drums 14 and 14' at the two ends of the line reach the respective ends of their travel they open the circuits of batteries 25 and 25' at the switches 26 and 26' at one end of their travel or 27 and 27' at the other end of their travel. It results that the magnets 30 and 30' are deenergized and the network 20—21—20 at the sending end is cut in and the network 20'—21'—20' at the receiving end is cut out. Accordingly, the over-all transmission equivalent of the system is unchanged, but the currents on the line are materially reduced in intensity, so that even if in the process of adjustment the applied electromotive forces at the sending end happen to be unusually large, the currents on the line are not unusually large as compared with normal transmission.

Of course it is desirable for normal transmission that the currents on the line shall have considerable intensity so that they shall not be masked at the receiving end by interference along the line. Therefore, for normal transmission it becomes desirable to change this state of affairs that has been described for the period of preliminary adjustment, and accordingly as has been shown, when the picture transmission actually starts, the magnets 30 and 30' are energized and the loss at the sending end is cut out and the equivalent loss at the receiving end

is cut in, so as to bring the transmission level up on the line but keep the over-all transmission equivalent unchanged for the system.

5 It will be comparatively seldom that the high lights in the picture will give as much as 100% transparency at the corresponding spot of the film on the drum 14. But between the edges of the film at 35 there will be 100% transparency, and hence at this point there would be a pulse of current on the line of maximum intensity. To prevent this I place the cam 34 on the shaft 16 in such position as to close the contacts 34' 15 when the gap between the edges of the film at 35 passes under the opening in the screen 13. The contact closure at 34' puts a short circuit across the output side of the filter F_1 so that excessive currents are prevented from going on the line. This short circuit 20 closed at 34' includes a pair of contacts at 31 which are of course closed by energization of the magnet 30 during picture transmission. However, during the preliminary 25 adjustment the short circuit is open at 31 so that if at this time a closure happens to be made at 34' it will be of no effect.

By my invention it becomes practicable to use a telephone circuit for picture transmission. A certain permissible transmission 30 level for the circuit is determined upon so that there will not be undue interference from the picture transmission circuit to neighboring telephone circuits. Then the result is secured that the currents are kept 35 well below this level even for the extraordinary conditions of preliminary adjustment and for the periodically recurrent high light condition due to the spaced edges of the transmitting film on its drum. 40

In the embodiment of my invention shown in Figs. 1 and 2, transmission is from a positive at the sending end to a negative at the receiving end or from a negative to a 45 positive. High light in the sending film causes large current on the line and this large current causes a wide opening of the light valve at the receiving end and a dark shade in the receiving film.

50 In Fig. 3 I have shown a skeleton film holder that may be employed instead of the glass drum of Fig. 1 at the transmitting end. The transmitting film has one pair of opposite edges resting on the collars 51 and the other pair of edges meeting along the 55 bar 52. In this case the system is adjusted so that transmission is from positive to positive or negative to negative and deep shade in the sending film gives large current on the line; hence also the current would be a maximum when the bar 52 intercepts the light to the photoelectric cell, but by my improvement the cam 34 of Fig. 1 60 operates to prevent putting this large current on the line.

I claim:

1. In the operation of a transmission line, the method of protecting neighboring lines from inductive interference, which consists in introducing a loss at the sending end and cutting out an equal loss at the receiving end 70 when certain excessive electromotive forces may be applied at the sending end, whereby the transmission level on the line is kept below a normal limit, and at the same time 75 the transmission equivalent of the complete system is unchanged.

2. In the operation of a picture transmitting system the method of protecting neighboring lines from inductive interference during the period of preliminary adjustment, which consists in automatically introducing a loss at the sending end and cutting out an equal loss at the receiving end when the apparatus is in the condition preliminary 85 to starting a normal picture transmission.

3. In the operation of a picture transmission system, the method of protecting neighboring lines from inductive interference, which consists in reducing the current on the 90 line when a regularly recurrent condition in the sending film would otherwise cause a large current to be applied on the line.

4. In combination, a picture transmitting system comprising at the transmitting end 95 means to send currents of intensity corresponding to the degree of light of successive elemental areas of a film, and at the receiving end means to expose a sensitive film to light adjusted in degree to the intensity 100 of the received currents, and automatic means to introduce loss at the sending end and cut out an equal loss at the receiving end when the apparatus is in the condition preliminary to starting the normal picture 105 transmission, said means being also operated to cut out the said loss at the sending end and introduce it at the receiving end when normal transmission starts.

5. In combination, a transmission line, a 110 loss network normally in the circuit at the receiving end and another loss network normally out at the sending end and means to reverse their relation to the circuit while the apparatus is in condition preliminary to 115 normal operation.

6. In a picture transmitting system, the drums 14 and 14', loss networks, one located at each end of the line, the one at the sending end being normally out of the line 120 and the one at the receiving end being normally in the line when the drums are at intermediate positions, and means actuated by the drums at the ends of their ranges of travel to reverse the conditions of the respective networks. 125

In testimony whereof, I have signed my name to this specification this 29th day of April 1925.

ELLIOT M. STAPLES.