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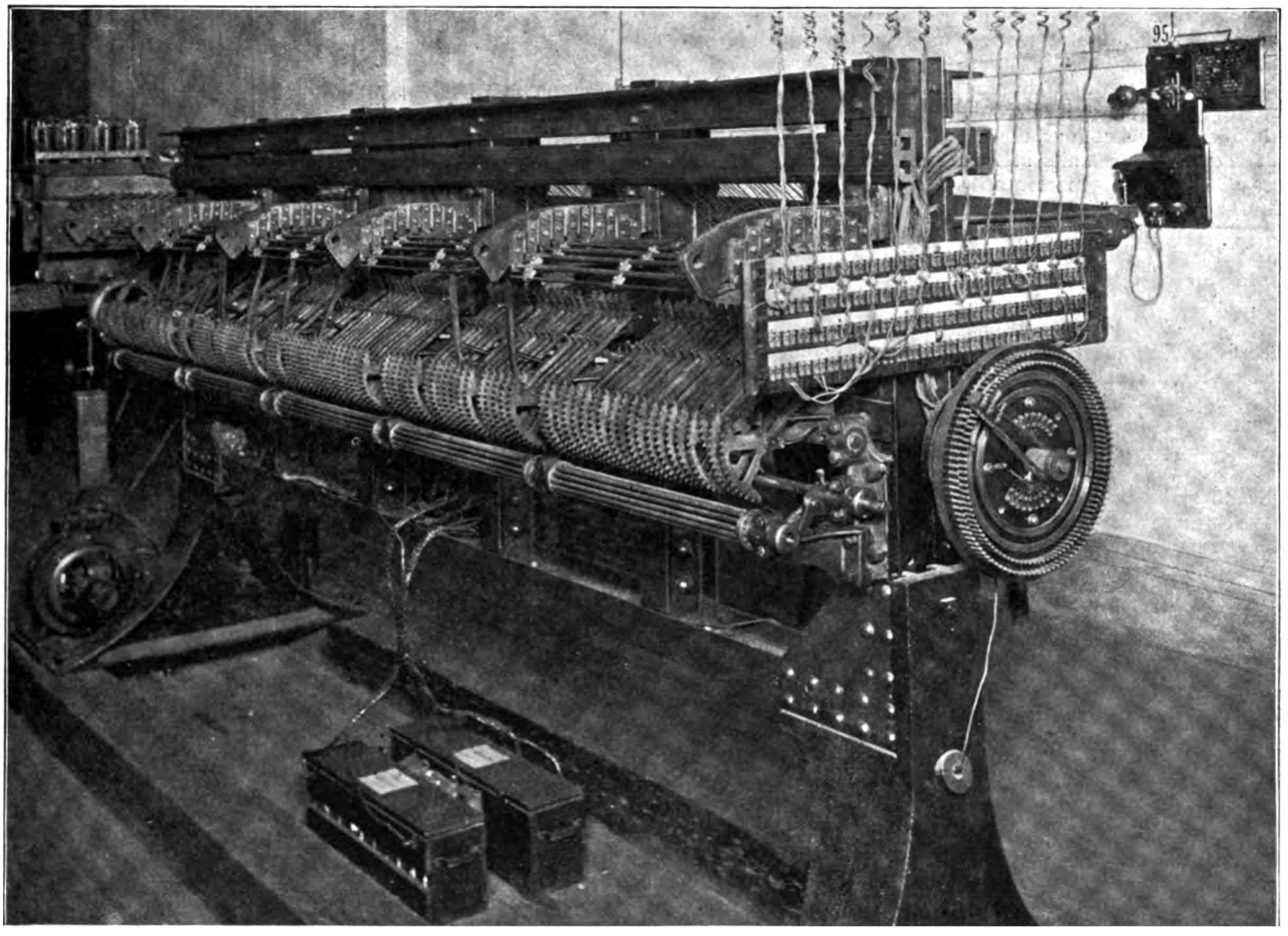
MANUAL vs. MECHANICAL OPERATING, ARTICLE I.

THE FALLER SYSTEM.—By ARTHUR VAUGHAN ABBOTT, C. E.

IF THE Nineteenth Century can be termed the Age of Machinery, the Twentieth Century will equally merit the name of the Age of Automatic Machinery. Put a penny in the slot and one may get a selection of chewing gum, ascertain one's weight, view the bones of one's hand illuminated by the X-rays, or receive a completed photograph of one's self, taken, developed, dried and delivered entirely automatically in the space of a few seconds. In the manufacture of watches automatic machinery has received its highest development. Put a bar of steel into one end of the machine, and from the other will issue completely formed watch gears, cut with almost mathematical precision.

under the name of the "Faller System," now presents itself to the telephonic fraternity. For several reasons the invention of Dr. Faller is unique, and its many points of merit are well worthy of careful study by those interested in this branch of telephony.

The first, broadest and most salient claim to originality of the Faller System is that it is not a mechanical *switchboard* at all, but is a mechanism that performs automatically exactly the same avocations as the regular operator, in the same order and manner as they occur in the manual switchboard. Thus, in fact, the apparatus is a *mechanical operator*. It is in this respect that the Faller invention is entirely different from and in many respects



FALLER MECHANICAL OPERATOR, FIG. 1.—Shows commutator, terminal board, subscribers' shuttles, some with connection established, shuttle locks which keep connection established until cleared out, and lantern pinion which brings shuttle to proper position for connection.

Among the developments of automatic machinery, the efforts to make operatorless telephone exchanges are exceedingly interesting, the Patent Office records teeming with all sorts of devices to enable *"every man to become his own operator."*

The Strowger Automatic Switchboard is probably the oldest of these devices, has attained the greatest success, and is the most widely known. Though it has been before the public for nearly a decade, its headway has been slow, and it is doubtful if a tenth of 1 per cent. of the telephone subscribers in America are served by automatic switchboards. Within the last few months another effort has been made to devise a mechanical switchboard, which, superior to other devices for automatic telephone service. It is difficult if not impractical to convey a clear conception of the apparatus without a working model, as even the best drawing or picture would be inadequate for the purpose.

Probably the best general idea can be gained by comparing the machine to a Jacquard loom, wherein the various subscribers' lines take the place of the threads of the woof, while a kind of carriage plays the part of the shuttle, temporarily weaving metallic threads between such pairs of woof threads as wish to converse with each other. Indeed, the analogy may be carried to a classical point in the resemblance of the shuttle to Penelope, for it pulls

out the metallic connection and restores the woof to its normal condition as soon as conversation has ceased.

The avoidance of all electro-magnetic mechanism that is called upon to exert any power is another exceedingly meritorious feature in design. The Faller board is driven by a prime mover of some sort, such as an electric motor, a small steam engine, countershaft, or the like, that is capable of supplying an ample amount of power, so that all that the electro-magnets employed in the machine are called upon to do, is to act as releases—starting and stopping the various portions of the mechanism at the proper times. Thus there is no danger to be apprehended from a failure of motive power to cause the apparatus to perform its functions promptly and in the desired manner. By supplying plenty of power, all portions of the apparatus can be made solid and substantial in all respects; contacts may be given any desired amount of pressure designed on the rubbing plan, and a host of similar advantages utilized.

At each sub-station the subscribers' instrument is provided with a calling device that consists of as many discs, or contact wheels, as there are significant figures in the highest number in the exchange. For example, in an office of 1,000 lines each subscriber would have three discs—one for units, one for tens, and one for hundreds. To call, say 485, a subscriber would set the hundred wheel at four, the ten wheel at eight and the units at five, and press a button. This momentarily grounds the line and allows the sender, which is in reality nothing more than the old familiar step-by-step movement so often weighed in the balance and found wanting, to transmit a series of impulses to the office corresponding to the numbers indicated on the several dials. Now, it is not difficult to imagine an electro-magnetic receiving mechanism so arranged as to enable the shuttle to pick out the subscriber's line thus specified and make connection therewith. When this is accomplished the bells of both subscribers ring as a signal to each that mutual connection is established and conversation can be commenced. When the message is completed the replacement of the receivers upon the respective switch hooks releases the shuttle and allows it to return to its normal position, thus placing each line in condition to receive another message. By having a number of shuttles, each of which takes the place of a single operator, as much business can be handled as it is possible to transact over the individual lines. By a very ingenious arrangement a busy test is so applied that if the shuttle finds a desired line already engaged in conversation it returns to its normal condition, the bell of the calling subscriber fails to ring, thus notifying him that the party desired is already engaged in conversation, and the call must be repeated at some subsequent time.

The Faller operator is substantially and solidly constructed. It is designed by excellent machinists, and from a mechanical and electrical standpoint leaves little to be desired. It appears to be decidedly simpler and cheaper in initial construction than any of the previous forms of automatic switchboards which have made their appearance. The following comparison has been made between an installation for 900 lines upon the Strowger and upon the Faller plans, and may be interesting as exhibiting relative complexity:

Comparison between the number of pieces in a 900-line board on Strowger and Faller plan.

	Strowger.	Faller.
Number of contacts	367,092	12,000
Number of switch machines	1,188	10
Number of relays	2,526	0
Number of local batteries	1,800	0

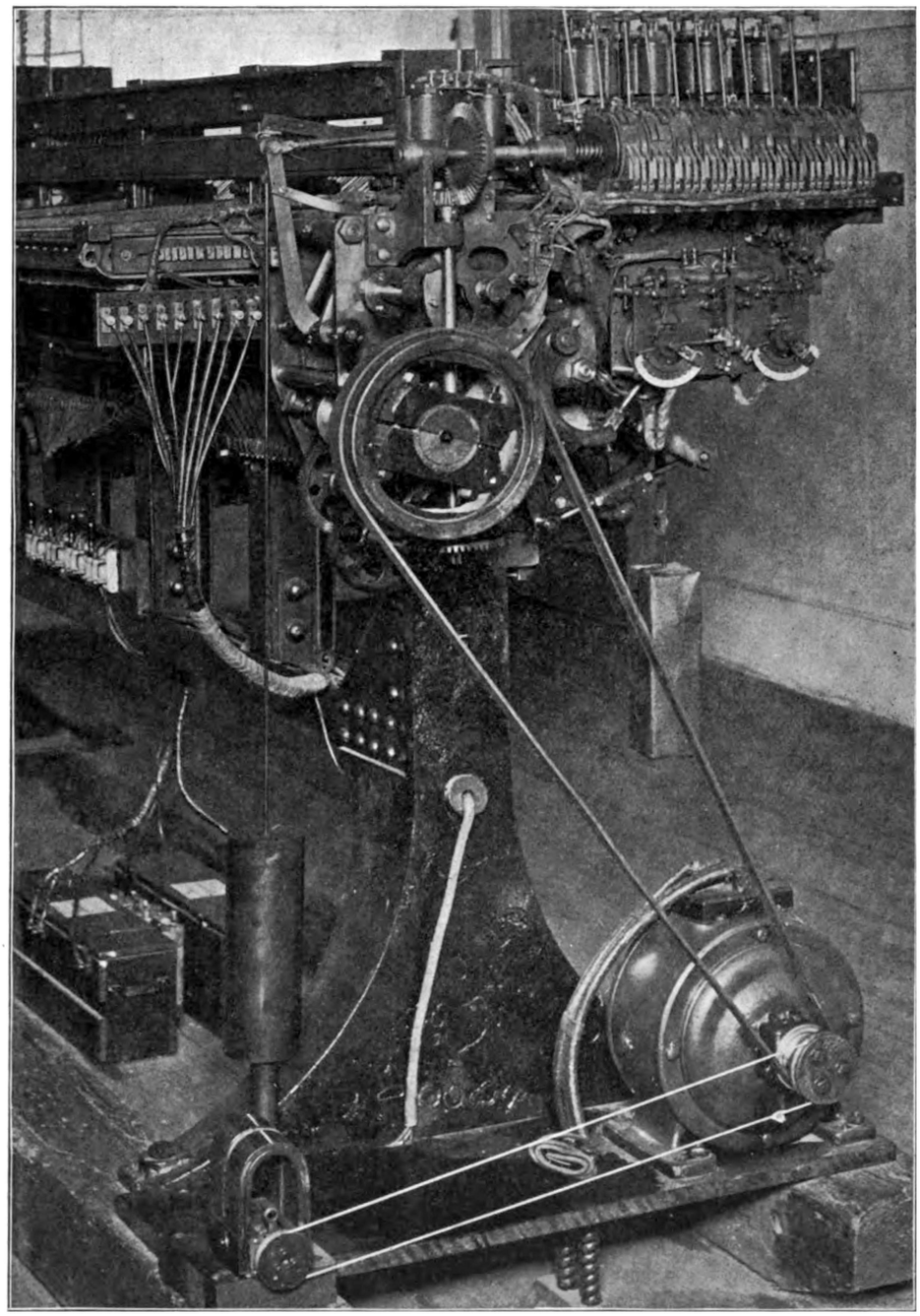
Automatic switchboards are usually alleged to possess one or all of the following advantages over manual ones:

First—Cheaper installation.

Second—Cheaper operation.

Third—The ability to give better service either in speed or reliability.

The Faller board, as so far exhibited, is planned in units of 100 lines each, but it is stated that only a single model has been made, so it is not as yet possible to quote prices for the apparatus from actual experience in manufacture. Good 100-line switchboards may be purchased from a number of reliable manufacturers for $300 or less, and it appears doubtful if further experience can demonstrate the possibility of making the Faller board with the degree of thoroughness that such apparatus demands, and sell the



FALLER MECHANICAL OPERATOR.

Fig. 2—Shows busy test, trouble detector, magneto generator motor, working mechanism, and busy wheel, which obviates all line magnets using only one magnet.

same—including probable profit and patent royalties—at a price that will enable it to compete with the rates asked for manual sections. It is well known that the cost of multiple switchboards of large size increases very rapidly with the size of the board, owing to the expense of multiple jacks. In days past, when jacks were sold for $1 apiece, this was a forcible argument, but at present, allowing for busy exchanges but fifty lines to an operator and assuming multiple jacks to cost but 15 cents each, the expense of the multiple portion of a 10,000-line switchboard would be $10 per line, or $1,000 for the equivalent of one Faller section. Possibly—nay, probably—a Faller board could be sold profitably at this price, but the number of switchboards of the capacity of 10,000 lines is so rare that all such installations may be easily counted on the fingers of one hand, and with smaller boards the handicap of the cost of multiple jacks soon decreases and becomes inappreciable.

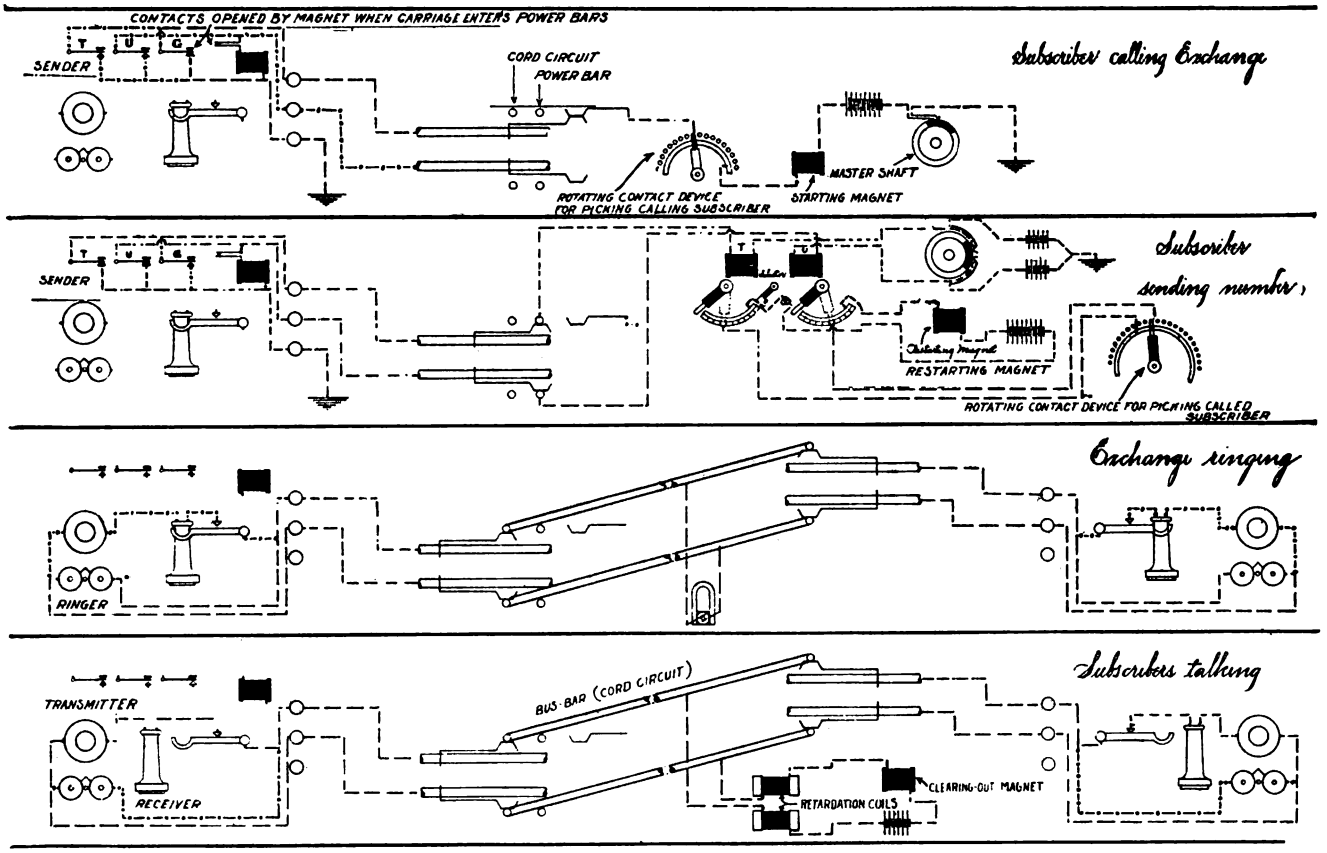
In different places the amount of these several items will vary, but in a general way they will stand something as follows in large offices for every 1,000 messages transmitted:

COST OF TRAFFIC.

Item.	Originating calls.	Trunk calls.	Total per M messages.
Labor	1.50	.70	2.20
Rent, light, heat	.15	.10	.25
Executive force	.50	.40	.90
Incidentals	.60	.30	.90
Total	2.75	1.50	4.25

In an exchange handling 100,000 calls per day the operating expense would amount to $425, and some persons jump to the conclusion that all of this expense would be abolished by the sub-

DIAGRAM SHOWING CIRCUITS OF THE FALLER SYSTEM.



IMPORTANT NOTE—In this diagram all APPARATUS is shown in solid lines.
WIRING is shown in dotted and broken lines.
BROKEN LINES show that part of the wiring on which circuit is closed.
DOTTED LINES show wiring on which circuit is open.

As but a single 100-line section of the Faller board has been constructed, the apparatus has never been tested even experimentally in larger units, and the question of trunking between sections when more than one is employed is unsolved excepting on paper. There the solution looks easy, as drawing-board problems frequently do. Consequently, considering cost of installation, the question is that of estimated expense on the one side, over practical experience on the other, and, to use a mining phrase—"the mill returns of an ore never reach the value of the fire assay." It is at least conservative to discount a little the somewhat excessive claims made as to economy of installation, as it is impossible to verify the optimistic assertions of probable saving. Naturally, the abolition of the familiar "hello girl," with all her alleged imperfections and the substituting of a service that is clock-like in regularity, is the chief claim of every automatic switchboard. In large exchanges the expense of serving the switchboard is often divided into four items:

First—Cost of labor.
Second—Rent, light and heat for the space occupied.
Third—Cost of the executive staff——manager, etc., and
Fourth—Incidentals.

stitution of an automatic switchboard. But, consider—a 100-line Faller section occupies about four times the space taken by 100 lines upon an ordinary manual board; it is not possible to put it in a *dark* room, as *some* attendance is constantly required; nor is it possible to put it in a *cold* room for the same reason, and it is inadvisable to put it in a poorly constructed building on account of fire risk. Rent, light and heat, therefore, will not be sensibly decreased per unit of floor space. As the board occupies four times as much space, this expense will be increased proportionately, and this item must be charged at $1. No economy can be made in the executive force, as every exchange—automatic or otherwise—requires the services of a manager and his staff in order to deal with the public. Further, though automatic machines require less labor than those which are not automatic, the kind of labor needed is of a higher class and demands a correspondingly increased rate of pay, so that it is fair to double the cost of executive force, allowing $1.80 for this item. Incidental expenses will be decreased, but, as an offset, power must be supplied to operate the Faller board, so that perhaps it is not unfair to allow the same amount for this item. The expense of labor may be credited as a clear gain. Thus, the cost per 1,000 mes-

sages would stand at $3.70 for the mechanical operator, against $4.25 for the manual board—a saving of 55 cents per 1,000 calls. Now, it is a question for experience to demonstrate whether the interest, maintenance and depreciation upon the probable increased cost of installation will not wipe out at least a portion of this saving.

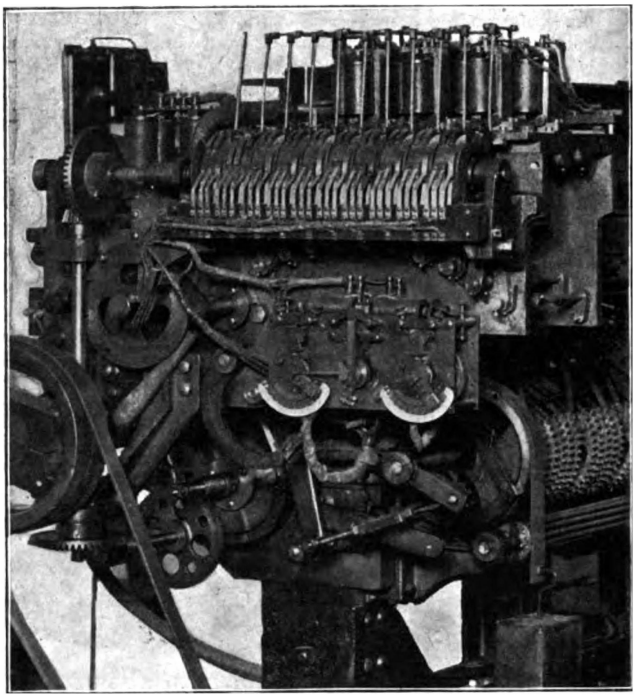
There remains the question of the ability of the automatic switchboard to afford a preferable service, and doubtless there will be two opinions in regard thereto. The advocates of the automatic can fully substantiate the claim that service will be more *regular* or uniform, and there is no gainsaying this argument. From the standpoint of speed the automatic exchange probably will *average* a service as rapid as that attained in common practice throughout the country. But in busy city offices, where, during the peak of the load, calls come in very rapidly, the automatic board will fall considerably behind the speed attained in the best modern exchanges under first-class operating management. If calls arrive more rapidly than they can be answered the machine very ingeniously stores them and continues to complete connections as fast as it can until all are answered. But subscribers want immediate service, and will not brook delay, particularly in the absence of a pacifying explanation, and this the machine cannot give.

The tendency in modern telephone practice is to relieve the subscriber as far as possible from all the work of obtaining a connection. This is partially the cause of the extensive development of the private branch exchange. Large business houses install their own switchboard and train their operators to get for them the various correspondents with whom they most frequently transact business. In many instances this service is so extended that the operator finds in the directory the numbers of desired parties. The operation of an automatic switchboard, on the other hand, inflicts upon the subscriber a greater amount of labor than with the manual board, for the calling subscriber must not only ascertain the number of his desired correspondent, but must manipulate the step-by-step mechanism in order to obtain the exchange. In small towns this may not be a serious handicap, but it is doubtful whether the modern business man would tolerate for a moment the additional labor, and he would certainly be very intolerant of the greatly increased number of errors which would occur from an attempt to perform this service for himself.

In the event of injury to a subscriber's line or to any portion of a manual switchboard, such as a cord, plug, jack, etc., either from accident or due to natural wear and tear, only the particular piece of apparatus incapacitated is thrown out of service, and the intelligence of the operator enables her to substitute duplicate parts from the reserve of her own cord shelf or borrow from her more fortunate neighbors on either hand. In the automatic, a ground on a subscriber's line or the failure of any part of a far more intricate and delicate mechanism puts a hundred lines *hors du combat* until relieved by the intervention of a particularly skilled attendant. Such an incident, which must be of more or less frequent occurrence, will cause most exasperating delays, particularly if happening at the busy hour.

Of the phonograph it was at first predicted that it would be extensively used in dictation, taking the place of the stenographer. Experience has not fulfilled this prophecy—not from any inability of the machine to faithfully record what is spoken to it, but its very mechanical precision prevents it from performing the service for which the stenographer is most valued—that of transcribing not what the dictator *said*, but what he *meant* to say. There are countless mechanical contrivances for the reproduction of music, from the music box at the head of the list to the organette, with its spool of paper, at the other end, but in spite of the mechanical precision with which sounds can thus be reproduced, the great masters of the piano receive year after year the most cordial welcome and the public pay fabulous prices to listen to their performances.

The camera will in a flash of a second reproduce with mathematical fidelity the finest detail of the most intricate scene. But photographs are rare than can be placed beside a Corot or a Turner. The animal studies of Muybridge are absolutely correct, but one hangs a Rosa Bonheur on the walls of a drawing-room. Ruskin says: "Art is nature seen through temperament." So with the telephone exchange—that service *can* be given mechanically is certainly true; that it *will* be is at present doubtful, and that most subscribers desire such service is untrue. It is "service through temperament" that is wanted, for experience shows that the human element, as in many other cases, is desirable, and, like the picture or the symphony, commands a higher price.



FALLER MECHANICAL OPERATOR, FIG. 3.
Shows selector, ringing cams, and clearing out magnets.

It is by no means intended to convey the idea that mechanical operation is impossible. Many conditions are conceivable under which it might not only be possible but desirable. But such cases are the exception and not the rule, and must be decided each for itself on its own merits. They are not as yet sufficiently developed to have accumulated any experience either as to cost of installation, cost of operation, cost of maintenance, or acceptability of service. To install a Faller operator is to try an experiment, pure and simple—a very interesting one, perhaps, but still an experiment, not a commercial undertaking. Those who are interested in the development of telephone apparatus can hardly find a better or more promising field in which to expend time, energy and money, but those who are in the business of operating to give commercial service and earn dividends had better allow "some other fellow" to do the experimenting.