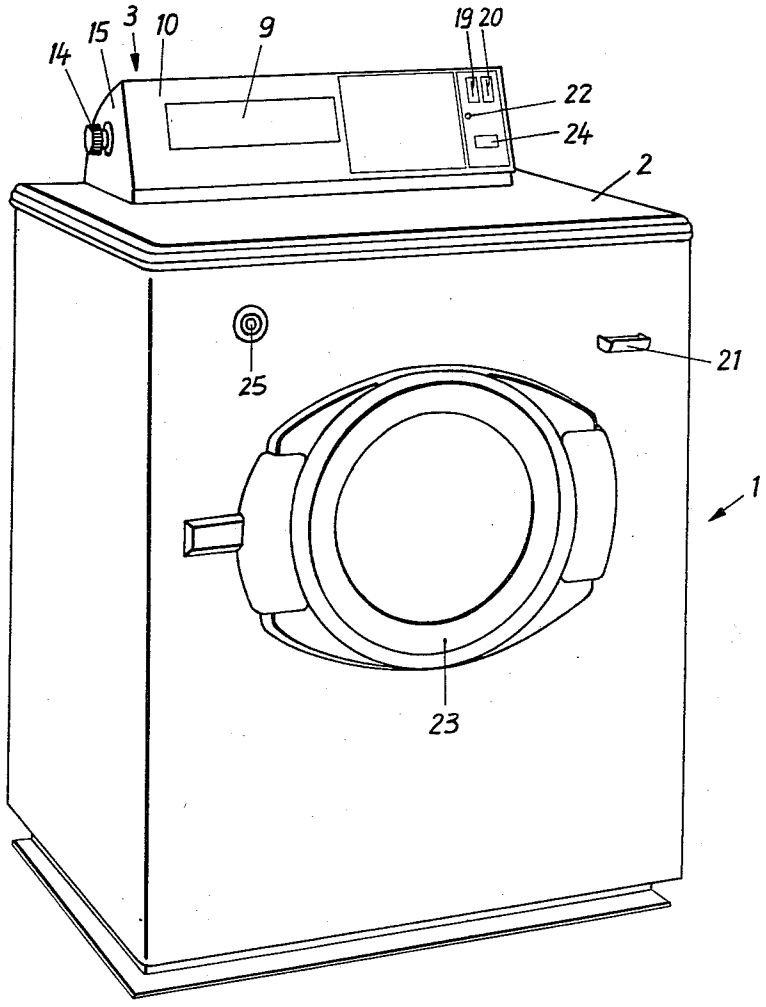
Nov. 12, 1963 J. J. RUB 3,110,384
AUTOMATIC WASHING MACHINE, MORE PARTICULARLY
FOR SELF-SERVICE LAUNDRIES
Filed Jan. 19, 1962 4 Sheets-Sheet 1

Fig. 1



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AUTOMATIC WASHING MACHINE, MORE PARTICULARLY FOR SELF-SERVICE LAUNDRIES

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Fig. 2

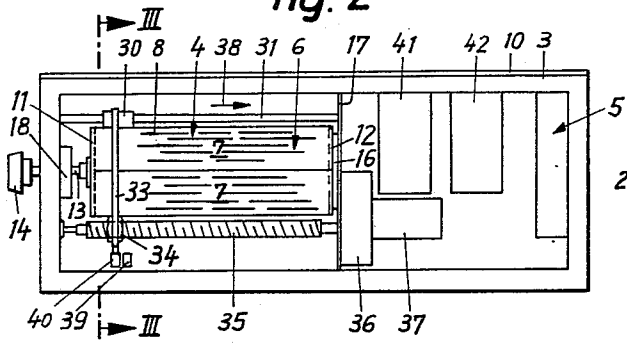


Fig. 3

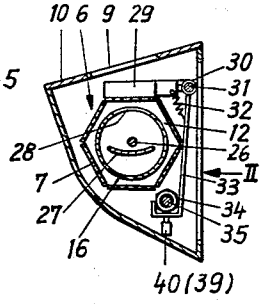


Fig. 4

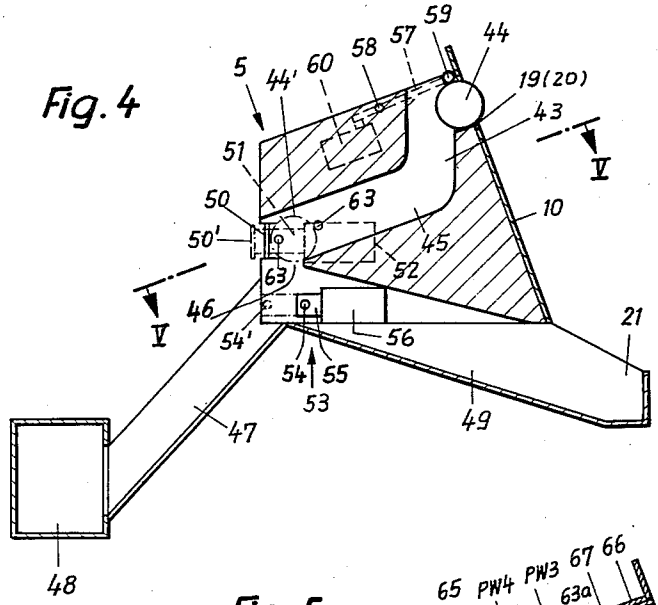
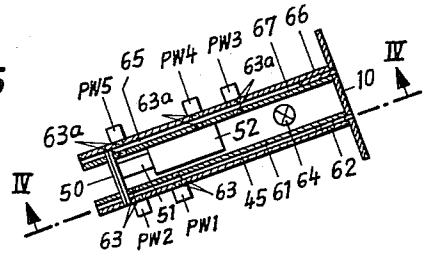


Fig. 5



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AUTOMATIC WASHING MACHINE, MORE PARTICULARLY FOR SELF-SERVICE LAUNDRIES

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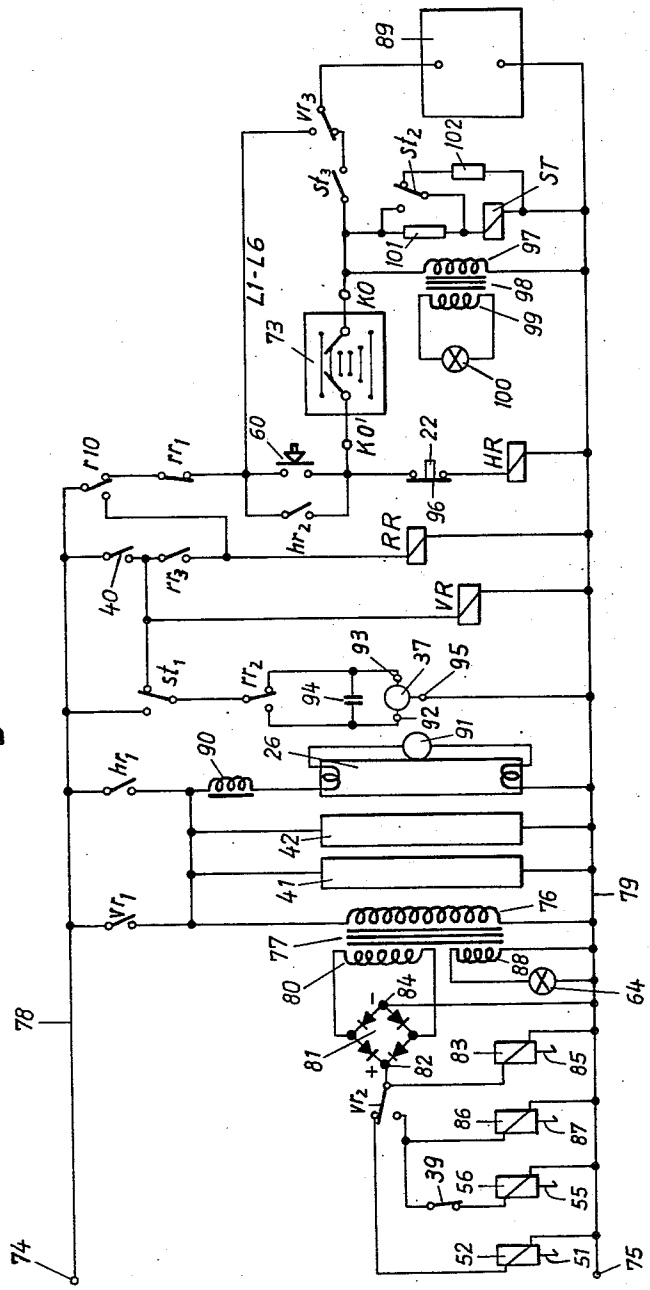
Fig. 6



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AUTOMATIC WASHING MACHINE, MORE PARTICULARLY FOR SELF-SERVICE LAUNDRIES

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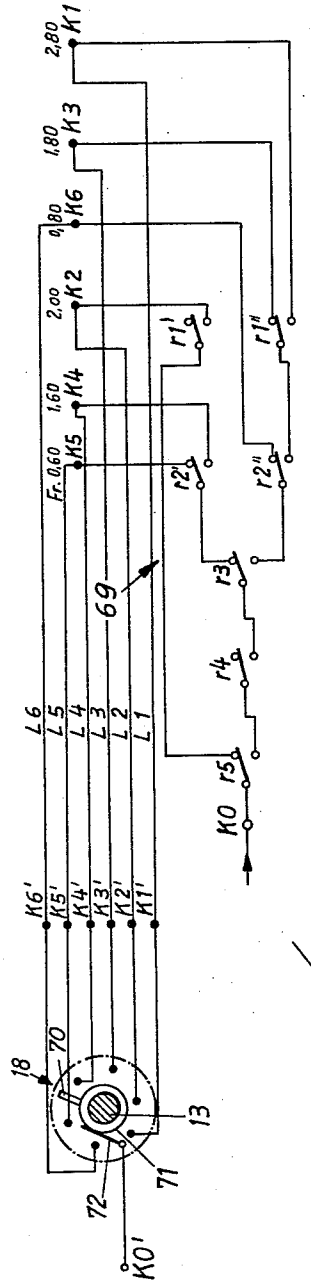

Fig. 7

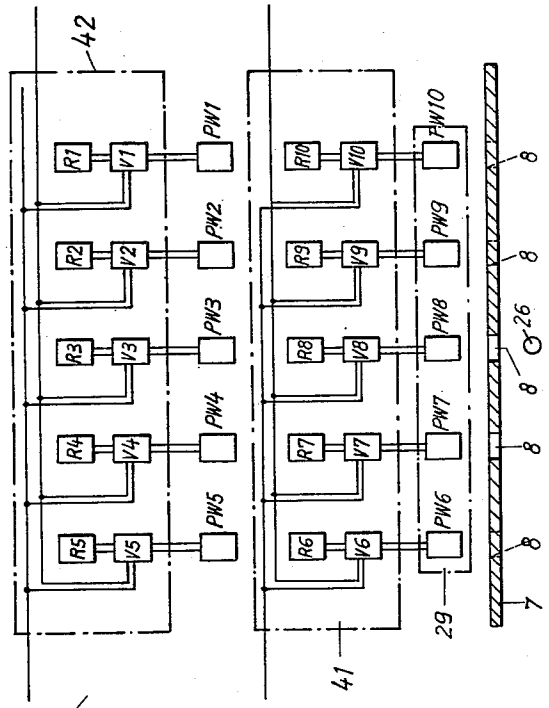

Fig. 8

United States Patent Office

3,110,384

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3,110,384

AUTOMATIC WASHING MACHINE, MORE PARTICULARLY FOR SELF-SERVICE LAUNDRIES

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Filed Jan. 19, 1962, Ser. No. 167,259
Claims priority, application Switzerland Nov. 3, 1961
14 Claims. (Cl. 194—9)

This invention relates to an automatic washing machine, more particularly for self-service laundries, having an actuating device, adapted to be controlled by means of a punched card, for the elements of the machine to be actuated when performing a washing programme, while the punched card is provided with holes arranged in rows, which determine the washing programme.

Washing machines of this type have already been erected in self-service laundries, and incorporated in the electrical power supply lead to the washing machine was an automatic coin receiver, which connected the connecting terminals of the washing machine to the main voltage for a period of time proportional to the amount paid, after coins had been inserted. This arrangement has the disadvantage that the said period of time may possibly be shorter than the duration of the washing programme which is determined by the punched card selected. This has the result that, in that case, the electric current is switched off in the middle of the programme cycle, so that an additional payment then has to be made. It is the aim of the present invention to avoid the said disadvantage—i.e., it is intended that at least that amount shall be paid in all circumstances which corresponds to the programme selected. It is further intended to avoid the further disadvantage, that in the case of the existing washing machines the punched cards are exposed to the danger of being inadvertently or deliberately taken away or damaged by the users.

In the case of the washing machine according to the invention, the said disadvantages are avoided by a rotatable prismatic drum, the sides of which are formed by punched cards corresponding to different washing programmes, and which is connected to a setting element whereby the required punched card can be brought between a pick-up head and a light source arranged in the interior of the punched card drum; by photo-sensitive elements provided in the pickup head and associated with the rows of the punched card, which control—via amplifiers—relays, the contacts of which in turn control the actuating device; by a coin receiving device; by a comparative circuit device, which compares the setting of the punched card drum with the amount paid by inserting coins into the coin receiving device and, in the case of payment sufficient for the price of the selected washing programme, establishes an electrical connection, the establishment of which is necessary for the automatic performance of the washing programme corresponding to the selected punched card.

Such washing machines may also be erected with advantage in blocks of flats, etc., where the money paid by the tenants is appropriated by the proprietor of the building.

In the case of a preferred embodiment of the said washing machine, it is further ensured that in the case of failure of the main voltage the coins inserted into the coin receiving device are automatically conveyed back into a return cup, whereas the customary automatic coin receivers retain the money.

One embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 shows a perspective view of an automatic washing machine,

FIGURE 2 a diagrammatically simplified bottom plan of certain parts which are contained in a subsidiary housing erected upon the housing of the machine, in the direction of the arrow II in FIGURE 3,

FIGURE 3 a section taken along the line III—III in FIGURE 2,

FIGURE 4 a diagrammatic vertical section through a coin receiving device located in the subsidiary housing, taken along the line IV—IV in FIGURE 3,

FIGURE 5 a section taken along the line V—V in FIGURE 4,

FIGURE 6 an electrical circuit diagram relating to the programme selection and to the control of the machine,

FIGURE 7 a diagram of the details of a comparative circuit device and of an assembly unit, which are represented as blocks in FIGURE 6, and

FIGURE 8 a diagram showing details of the pickup head and of another assembly unit represented as a block in FIGURE 6.

The washing machine shown in FIGURE 1 exhibits a housing 1 which contains the principal components of a well-known washing machine manufactured in large series by the applicant, more particularly a washing drum, a drive motor for the said drum, contactors, valves etc. In the case of this known machine, it is possible by the aid of punched cards to select various washing programmes, as is described in Swiss Patent Number 344,393. When the punched card corresponding to the required programme is introduced into a pickup device mounted on the housing cover and a starting knob is actuated, slot-shaped holes located in the punched card are mechanically read and electrical contacts are thereby actuated which automatically control the entire programme cycle and switch the machine off upon termination of the programme.

Now, in the case of the present machine, mounted on the housing cover 2 instead of the mechanical pickup device referred to, which scarcely projects above the cover, is a subsidiary housing 3 which contains a programme selection device 4 and a coin receiving device 5 (see FIGURE 2). The selector device 4 exhibits a drum 6 in the form of a regular hexagonal prism, the sides of which are formed by six punched cards 7, which correspond to various washing programmes. A number of slot-shaped holes 8 arranged in five lines in each case are indicated in purely diagrammatic manner in the two punched cards 7 visible in FIGURE 2. The person using the washing machine can see only the punched card 7 which is located at the top in FIGURE 3, and is positioned behind a window 9 having a glass pane and provided in a faceplate 10.

The drum 6 exhibits at one end an end plate 11 and at the other end an externally hexagonal ring 12, to which plate and ring the punched cards 7 consisting of sheet metal are secured in an exchangeable manner—e.g., by means of screws not shown. However, it will usually be unnecessary to exchange the punched cards, and even if it is intended to perform such exchange, this should in no circumstances be done by the persons using the machine, but by the staff of the self-service laundry in which the machine is erected, or by the staff of the actual firm supplying the machine.

The faceplate 11 is connected at its centre by a shaft 13 to an operating knob 14, and at its point of passage through the side wall 15 of the subsidiary housing 3 it is mounted in the said wall. The ring 12 provided at the other end of the drum 6 is supported against a hollow cylinder 16, which is floatingly secured to a partition wall 17.

On the shaft 13 is mounted the movable part of a se-

lector switch 18, which at the same time is provided with a ratchet device of a customary type—not shown—for the purpose of retaining the drum 6 in six positions staggered by 60° with respect to one another, so that by rotating the knob 14 one or the other of the programmes determined in the six punched cards 7 may be conveniently brought accurately in registry with the window 9.

In the top right-hand corner of the faceplate 10 are provided two slots 19 and 20, which serve for the insertion into the coin receiving device 5 of coins having an individual value of 1 Swiss franc or 20 rappen respectively. A different price—e.g., Fr 2.80, or 2.00, or 1.80, or 1.60, or 0.80, or 0.60—is payable for the performance of each of the six washing programmes which can be selected by setting the drum 6, while the highest price is of course payable for the programme of longest duration. As will be explained in detail hereinafter, the machine is set in motion automatically when, after the required punched card 7 has been set behind the window 9, the coins corresponding to the price written on the said punched card are inserted into the slots 19 and 20.

Inappropriate coins—e.g., coins having an individual value of 2 or 10 rappen—fall automatically into a coin return cup 21 provided on the front face of the housing 1. A correcting button 22 is provided beneath the slots 19 and 20 on the faceplate 10. After the coins have been inserted into one or the other of the slots 19 and 20, the drum 6 is automatically locked in the selected position, in a manner to be explained in detail hereinafter. Should it be noticed when inserting the coins that an error has been made in setting the programme, or if, for example (due to a disturbance of any kind), one is no longer certain as to what coins one has already inserted into the slots 19 and 20, then it is sufficient to depress the correcting button 22 in order to bring about the return of the coins, and hence also the unlocking of the drum 6. However, the correcting button 22 is only effective so long as the starting of the selected washing programme has not yet occurred, or at the most up to one minute after the said start. After this, it is no longer possible to influence the machine in any manner, nor is it any longer possible to open the door 23 provided in the housing 1, and serving as customary for the charging and discharging of the washing drum, until the programme has been performed.

Beneath the correcting button 22 is located a translucent pane 24 with the inscription "Coin Insertion Correct." When the coins inserted correspond to the price of the programme set, the said inscription is illuminated, and starting of the machine then occurs after a slight delay. A signal lamp 25 provided on the front face of the housing 1, indicates in customary manner that the machine is in service.

Now, reading of the punched cards 7 does not take place by mechano-electrical means, as in the case of the known washing machine, but by photo-electrical means. For this purpose, in the interior of the hollow cylinder 16 and along the axis of the drum 6 there is arranged a fluorescent tube 26 (see FIGURE 3), which extends almost over the entire length of the drum 6 and is fed by electrical leads, not shown. Mounted along the fluorescent tube 26 in the hollow cylinder 16 is a reflector 27, which reflects the light incident upon it from the fluorescent tube towards the window 9, when it passes first through a window 28 provided in the hollow cylinder 16 and then through the slots 8 of the punched card 7 selected. Of course, instead of the hollow cylinder 16, any assembly element of different shape may also be secured to the partition wall 17, the fluorescent tube 26 and the reflector 27 being mounted therein.

In order to read the punched card 7 selected, a pickup head 29 containing a photo-resistance is provided, which is mounted pivotable about an axis 31 by means of a hinge 30 and is adapted to slide upon said axis. A weak spring 32 tends to hold the pickup head 29 upon the punched card 7 which is to be read, but permits the pickup head 29 to escape when the drum 6 is rotated. The hinge 30 is firmly connected by a flat bar 33 to a nut 34 which is mounted upon a screw-threaded spindle 35, so that when the said spindle 35 rotates the pickup head 29 is moved in the longitudinal direction of the punched card 7.

The screw-threaded spindle 35 is driven via a reduction gear 36 by a reversible synchronous motor 37. The gear 36 is so constructed that when the reversible motor 37 rotates in one direction the spindle 35 is driven slowly, namely so that the pickup head 29 requires approximately 90 minutes to read the entire length of the punched card 7 in the direction of the arrow 38, and switching off does not therefore occur automatically before the end of the punched card. When the reversible motor 37 rotates in the other direction, on the other hand, a portion of the reduction gear becomes ineffective, so that the pickup head 29 is restored very rapidly—e.g., in approximately 1–2 minutes—into its original position, in the vicinity of which are mounted two microswitches 39 and 40, which are actuated by the nut 34, and the function of which will be explained hereinafter.

In order to bring about the speed variation upon a change of the direction of rotation, the gear 36 exhibits, for example, a first reduction stage arranged between its input shaft and a first counter-shaft, and a second reduction stage arranged between the said first and a second counter-shaft (not shown); on each of the two countershafts a gearwheel is rotatably mounted, being connected to its shaft via a direction-dependent coupling and engaging with a gearwheel mounted on the output shaft, while the operative directions of the two couplings are opposite to one another.

Also arranged in the subsidiary housing 3, according to FIGURE 2, are two amplifier/relay assembly units 41 and 42, the purpose of which will likewise be explained hereinafter.

Now, first of all, the construction and principle of operation of the coin receiving device 5 will be described with reference to the diagrammatic FIGURES 4 and 5. The device 5 exhibits behind the slot 19 a vertical shaft 43 of flat cross-section adapted to the 1-franc piece 44 and merging at the bottom into a gently inclined channel 45 of equal cross-section, which is provided at the bottom with an aperture 46, through which the coin 44 can fall either via an inclined channel 47 into a coin box 48 or via an inclined channel 49 into the return cup 21.

A blocking element 50 is secured to the armature 51 of an electro-magnetic solenoid 52. So long as the solenoid 52 is energised, the armature 51 and blocking element 50 occupy the position shown by continuous lines in FIGURES 4 and 5, the coin occupying the position 44′ is unable to fall through the aperture 46. When the solenoid 52, which is designated the "coin holding solenoid" for this reason, is no longer energised, the blocking element 50 assumes the position 50′ shown by chain-dotted lines in FIGURE 4, in obedience to a spring, not shown; in this position, it clears the aperture 46, so that the coin 44 occupying the position 44′, and any further coins of the same type which may be located in the channel 45, are able to leave the said channel 45 in a downward direction.

In order to direct the coin 44 into the coin box 48 or into the return cup 21, a coin deflector 53 is provided, which exhibits a short horizontal deflecting pin 54 which is secured to the armature 55 of an electro-magnetic solenoid 56. When the said solenoid 56, designated the "coin deflector solenoid," is energised, and the pin 54 consequently occupies the position shown by continuous lines in FIGURE 4, then, as may be seen, it deflects the coin 44 which falls out of the aperture 46 into the channel 47. By contrast, when the solenoid 56 is unenergised, so that the pin 54 occupies the position 54′ shown by chain-dotted lines, it deflects the coin 54 into the channel 49.

Behind the insertion slot 19 there is provided a feeler lever 57 which is mounted pivotably at 58 and is provided at its free front end with a feeler pin 59 running perpendicularly to itself, which is located immediately behind an upper portion of the slot 19. The other free end of the feeler lever 57 acts upon a microswitch 60, so that when a coin 44 of appropriate diameter is inserted, the switch 60 is briefly closed. Coins which are too thin are deflected to the side by intrinsically known means, not shown, before they can pass into the coin channel 45, and are likewise fed to the return cup 21.

The channel 45 is bounded by two comparatively thin walls 61 and 62—consisting for example of sheet metal—in each of which are provided two holes 63 which correspond in pairs, opposite which two photo-resistances PW1 and PW2 are mounted on the external side of the wall 62. The light emanating from an incandescent lamp 64 is able to pass through the holes 63 onto the two photo-resistances PW1 and PW2 only when there is no coin 44 in the channel 54. If only one coin 44 is in the channel 45, then light reaches only the photo-resistance PW1, but not the photo-resistance PW2. If two (or more) coins 44 are present in the channel 45, on the other hand, then both the photo-resistances PW1 and PW2 are shaded by the said coins 44.

Behind the 20-rappen insertion slot 20 there is further located a vertical shaft (not shown), which directs the coin into an inclined channel 65 (see FIGURE 5), which is bounded by two walls 66 and 67 and runs parallel to the channel 45. In each of the walls 66 and 67 there are provided three holes 63*a* corresponding in pairs opposite which three photo-resistances PW3, PW4 and PW5 are mounted on the external side of the wall 68. But the intervals between the pairs of holes 68, and between the said photo-resistances PW3–PW5, are so dimensioned that at least four coins are required in the channel 65 in order to shade the photo-resistance PW3, at least three coins in order to shade the photo-resistance PW4, and at least one coin in order to shade the photo-resistance PW5.

The incandescent lamp 64, the coin holding solenoid 52, the coin deflector solenoid 56 and the switch 60 are mounted between the planes of the channels 45 and 65 and are associated with both coin paths in such manner that the feeler pin 59, which is slightly cranked so as to correspond to the different diameters of the 1-franc and 20-rappen coins, briefly closes the switch 60 when a coin is inserted into the slot 19 or into the slot 20, that the blocking element 50 blocks or clears both channels 45 and 65 in common, and that the deflecting pin 54 feeds the coins coming from both the said channels in common either to the coin box 48 or to the return cup 21.

According to FIGURE 7, the photo-resistances PW1–PW5 each control an amplifier V1–V5, the output of which is connected to a relay R1–R5. The amplifiers V1–V5 and the relays R1–R5 are mounted in the amplifier/relay assembly unit 42, which is adapted to be inserted as an entity into the subsidiary housing 3.

The amplifiers V1–V5, which may contain as amplifier elements for example, cold-cathode valves or transistors, are so constructed that the relays R1–R5 are energised when the corresponding photo-resistances PW1–PW5 are in darkness—i.e., are shaded by a coin.

The contacts of the relays R1–R5 are designated *r*1′ and *r*1″, *r*2′ and *r*2″, *r*3, *r*4 and *r*5 respectively. The said contacts are shown in the normal position in FIGURE 7, and are connected to one another to form a logical circuit 69 having the one input terminal K0 and six output terminals K1–K6, which are associated with the six programmes which can be selected by means of the drum 6. The prices of the said programmes are written above the terminals K1–K6 in FIGURE 7 and are Fr 2.80, 2.00, 1.80, 1.60, 0.80 and 0.60 respectively. It will readily be seen that in the normal position shown—i.e. when the photo-resistances PW1–PW5 are illuminated—none of the output terminals K1–K6 is connected to the input terminal K0.

Assuming that two 1-franc coins are present in the coin channel 45 and four 20-rappen coins in the coin channel 65, so that all the photo-resistances PW1–PW5 are shaded and all the relays R1–R5 energised, and hence all the relay contacts have transited, it is likewise readily apparent that the output terminal K1, and namely this output terminal alone, is connected to the input terminal K0, corresponding to the stated price of Fr 2.80. In similar manner, each of the other output terminals K2–K6 is also connected to the input terminal K0 when the appropriate coins are present in the channels 45 and 65.

The left-hand portion of FIGURE 7 shows diagrammatically the selector switch 18, the movable contact arm 70 of which is firmly connected to the drum shaft 13 and to a slip-ring 71 mounted thereon. A sliding contact 72, which is connected to an input terminal K0′, slides upon the slip-ring 71. The selector switch 18 further exhibits six non-designated immovable contacts which are arranged in a circle, are staggered by 60° and each of which is connected to an output terminal K1′–K6′. In the six ratchet positions of the selector switch 18, the contact arm 70 rests upon one or other of the immovable contacts, so that the input terminal K0′ is connected to one or other of the output terminals K1′–K6′, according to the programme selected.

The output terminals K1′–K6′ of the selector switch 18 are connected by conductors L1–L6 to the correspondingly numbered output terminals of the logical circuit 69, and it is apparent that the two terminals K0 and K0′ become connected to one another when the amount paid in corresponds to the price of the programme set. As remains to be shown hereinafter, the establishment of the said connection is a necessary condition for the machine to be set automatically in operation. It is irrelevant whether the 1-franc coins or the 20-rappen coins are inserted first. However, one must not attempt to insert—for instance—eight 20-rappen coins in order to make up the amount of Fr 1.60; on the contrary, it is necessary to insert one 1-Fr coin and three 20-rappen coins for the choice of the fourth programme. Errors which occur during insertion of the coins can be remedied by means of the correcting button 22, as already mentioned. If a smaller amount is inserted than corresponds to the selected programme, then the machine will in no circumstances commence operating; nor will it do so if a larger amount than necessary is paid, subject to the provision that the said larger amount corresponds to the price of another programme—i.e., if for instance Fr 1.80 is paid instead of 1.60. On the other hand, it is possible, for example, for five 20-rappen coins to be inadvertently inserted at first, and then two 1-franc coins, and for the programme which costs only Fr 2.80 to be thereby set in motion. However, such a case will rarely occur in practice, and the user may reasonably be expected to bear this slight loss, which results from his inattention.

The entire circuit device shown in FIGURE 7, which compares the position of the drum 6 with the amount paid, and which is therefore designated the comparative circuit device, is represented in the circuit diagram according to FIGURE 6 as a block 73, on which the conductors L1–L6 and two symmetrical selector switches are indicated, representing the selector switch 18 and the logical circuit 69. The said circuit device might also perhaps be designated a coincidence circuit device.

The circuit diagram according to FIGURE 6 shows two input terminals 74 and 75 which are connected to the customary low-tension main supply of 220 volts, 50 c./s. Via a first contact vr_1 of an interlocking relay VR, the primary winding 76 of a transformer 77 is connected to the conductors 78 and 79 communicating with the input terminals 74 and 75. To a first secondary winding 80 of the transformer 77, which delivers a voltage of—for example—24 volts, there is connected a rectifier

bridge 81, the positive pole 82 of which is connected via an electro-magnetic solenoid 83 to the conductor 79, to which the negative pole 84 of the bridge is also connected. The armature 85 of the solenoid 83 is constructed as a lock and is fitted to the selector switch 18 in such manner that when the solenoid 83 is energised, the said armature prevents rotation of the drum 6, with the result that it is impossible to vary the drum setting during the cycle of the programme.

The positive pole 82 is further connected, via a second contact vr_2 of the interlocking relay VR—provided the said relay VR is not energised—to the coin holding solenoid 52, the armature 51 of which is provided with the blocking element 50 (see FIGURES 4 and 5). When the interlocking relay VR is energised, the positive pole 82 is connected, on the one hand via the switch 39 (see FIGURE 3) and the coin deflector solenoid 56 (see FIGURES 4 and 5), and on the other hand, in parallel therewith, via an electro-magnetic solenoid 86, to the conductor 79. The armature 87 of the solenoid 86 is constructed as a lock and is so fitted at the door 23 (see FIGURE 1), that it is impossible to open the said door 23 so long as the solenoid 86 is energised.

A second secondary winding 88 of the transformer 77, which delivers a voltage of—e.g.—5 volts, is connected, on the one hand directly, and on the other hand via the incandescent lamp 64 mounted in the coin receiving device 5, to the conductor 79.

Located in parallel with the primary winding 76 are the two amplifier/relay units 41 and 42, whereof the unit 42 has already been explained with reference to FIGURE 7. The unit 41, which is of entirely similar construction to the assembly unit 42, is shown in detail in FIGURE 8. It in turn embraces five amplifiers V6–V10, the inputs of which are connected to five photo-resistances PW6–PW10 and their outputs to five relays R6–R10. The photo-resistances PW6–PW10 are accommodated in the pickup head 29 and are associated with the five lines of the particular punched card 7 being read, in which the slots 8 are located. In the case of that position of the punched card 7 which is shown in cross-section along the reading line, which has been arbitrarily assumed in FIGURE 8, only the photo-resistances PW7 and PW8 are illuminated by the fluorescent tube 26 through slots 8 provided in two rows, whereas the slots 8 of the other three rows do not extend through the cross-section shown.

By contrast with the amplifiers V1–V5 of the unit 42, the amplifiers V6–V10 of the unit 41 are so constructed that the relays R5–R10 are energised when the photo-resistances PW6–PW10 associated with them are illuminated. The contacts of the relays R6–R10 serve to control the actuating elements of the washing machine—for example, contactors for the washing drum drive motor, solenoid valves, actuating elements of an introductory device for washing agents, an electrical heating system, etc., exactly as the said elements are controlled by the contacts actuated mechanically by the punched card in the case of the applicant's known washing machine to which reference was made initially. The said well-known actuating device is represented in FIGURE 6 by a block 89, which therefore also contains the contacts (not shown) of the relays R6–R10. In addition to the relay contacts contained in the actuating apparatus 89 and replacing the known mechanically controlled contacts, one of the relays R6–R10—e.g. the relay R10—exhibits a contact $r10$, which connects the conductor 78 to a first contact rr_1 of a restoring relay RR when the relay R10 is unenergised. On the other hand, when the relay R10 is energised the contact $r10$ connects the conductor 78 via the restoring relay RR to the conductor 79.

Mounted in parallel with the units 42 and 41, which have been explained with reference to FIGURES 7 and 8, is the series circuit of a series choke coil 90 and the fluorescent tube 26, while the electrodes of the said fluorescent tube 26 are connected to one another in customary manner via an ignition starter 91. Connected in parallel with the relay contact vr_1 is a contact hr_1 of a holding relay HR, which is open when the said holding relay HR is not energised.

A starting relay ST exhibits a first contact st_1 which, the said relay ST being energised, connects the conductor 78 to a second contact rr_2 of the restoring relay RR, which is connected, according to the state of energisation of the said relay RR, to one or the other of two connecting terminals 92 and 93 of the reversible synchronous motor 37 (see FIGURE 2). The terminals 92 and 93 are connected to one another in customary manner via a condenser 94, whereas a third motor connecting terminal 95 is connected to the conductor 79, with the result that the motor 37 rotates in one or the other direction, according to whether the current flows to the terminal 95 from the terminal 92 or from the terminal 93.

The restoring relay RR is connected on the one hand, via a third and normally open contact rr_3 of the same and the likewise normally open switch 40 (see FIGURE 3) to the conductor 78, and on the other hand directly to the conductor 79. The holding relay HR is connected on the one hand via a normally closed contact 96, which can be opened by the correcting button 22, the normally open coin insertion switch 60 and the contact rr_1 and $r10$ to the conductor 78, and on the other hand directly to the conductor 79. A second contact hr_2 of the holding relay HR is connected in parallel with the coin insertion switch 60.

Connected in parallel with the series circuit of the contact 96 and of the holding relay HR is a series circuit formed by the comparative circuit device 73 and the primary winding 97 of a transformer 98. The secondary winding 99, delivering a voltage of—e.g.—5 volts, feeds an indicator lamp 100, which is mounted behind the pane 24 bearing the inscription "Coin Insertion Correct."

Connected in parallel with the primary winding 97 is a series circuit formed by the starting relay ST and a retarding resistance 101 having a negative temperature coefficient. A second contact st_2 of the starting relay ST, when in its operative position, short-circuits the retarding resistance 101, whereas in the normal position it switches a loading resistance 102 in parallel with the starting relay ST.

The control device 89 can be switched in parallel with the primary winding 97 via a third contact st_3 of the starting relay ST and a third contact vr_3 of the interlocking relay VR. In another switching position of the contact vr_3 on the other hand, the control device is connected via the contact rr_1 and $r10$ to the conductor 78.

The circuit described, the contacts of which are shown in FIGURE 6 in the normal position of the machine, or when the relay is unenergized, operates in the following manner:

By the insertion of a coin into one of the slots 19 or 20, the coin insertion switch 60 is briefly closed, so that—in the event that a voltage is present at the input terminals 74 and 75—the holding relay HR becomes energised in the circuit 74, 78, $r10$, rr_1, 60, 96, HR, 79, 75 and holds itself after the switch 60 opens via its hr_2, which is now closed. Via the contact hr_1, which is now likewise closed, voltage is applied to the primary winding 76 of the transformer 77, the amplifier/relay units 41 and 42, and the fluorescent tube 26 with its series choke coil 90. The tube 26 is ignited by means of the ignition starter 90, so that it acts through the slots 8 of the selected punched card 7 upon the pickup head 29. Simultaneously, the lamp 64 of the coin receiving device 5 is also switched on via the secondary winding 88 of the transformer 77. The rectifier bridge 81 fed via the secondary winding 88 energises the coin holding solenoid 52 in the circuit 82, vr_2, 52, 79, 84, so that the blocking element 50 fitted to the armature 51 blocks the outlet apertures 46 of the coin channels 45 and 65. Similarly,

the solenoid 83 becomes energised in the circuit 82, 83, 79, 84, so that its armature 85 locks the drum 6 in the selected position.

When, after the insertion of further coins, the comparative circuit device 73 ascertains in the manner which has already been described exhaustively with reference to FIGURE 7 that the correct price for the selected programme has been paid, and thus connects the two input terminals K9 and K9' of the logical circuit 69 or of the selector switch 18 to one another via one of the conductors L1–L6, a current flows in the circuit 74, 78, *r*10 rr_1, hr_2, 73, 97, 79, 75, so that the transformer 98 becomes energised and the indicator lamp 100 indicates the payment of the correct amount. There now likewise flows, in the current branch 101, ST2, 102 located in parallel with the transformer primary winding 97, a current which by reason of the negative temperature coefficient of the retarding resistance 101, increases after a short retardation to a value which is sufficient to energise the starting relay ST.

The energisation of the starting relay ST causes its contact st_2 to transit, so that the retarding resistance 101 is short-circuited and the loading resistance 102 is cut out. Transiting of the contact st_1 completes the circuit 74, 78, st_1, rr_2, 93, 37, 95, 79, 75, so that the motor 34 rotates in the forward direction, and the screw-threaded spindle 35 slowly driven thereby via the gear 36 moves the pickup head 29 over the punched card 7 in the reading direction indicated by the arrow 38 (see FIGURE 2). The closing of the contact st_3, which takes place simultaneously, causes the actuating device 89 to be energised in the circuit K9, st_3, vr_3, 89, 79 and thus to perform the selected programme, while the contacts of the relays R6–R10 contained in the said actuating device 89 are controlled by the punched card 7 via the pickup head 29 in the manner already described.

After approximately one minute, the switch 40 is closed by the nuts 34 mounted on the screw-threaded spindle 35, so that the interlocking relay VR becomes energised in the circuit 74, 78, 40, VR, 79, 75. The contact vr_1 is thereby closed thus rendering ineffective any possible opening of the contact hr_1. Furthermore, the contact vr_2 is made to transit, so that the coin holding solenoid 52 becomes de-energised and the blocking element 50 clears the outlet apertures 46 of the coin channels 45 and 65. By contrast, the coin deflecting solenoid 56 now becomes energised in the circuit 82, vr_2, 39, 56, 79, 75, so that the deflector pin 54 fitted to its armature 55 directs the coins falling from the channels 45 and 65 into the coin box 48.

By the transiting of the contact vr_2, the solenoid 86 also becomes energised in the circuit 82, vr_2 86, 79, 84, so that its armature 87 locks the door 23, which from now on cannot be opened until the programme cycle expires. Moreover, by the picking up of the interlocking relay VR, its contact vr_3 is made to transit, so that the control device 89 is now connected via rr_1, *r*10 and 73 to the input terminal 74, the comparative circuit device 73 and the holding relay contact hr_2 being bypassed. It is now no longer possible to influence the programme in course by means of the correcting button 22.

By contrast, before the interlocking relay VR has picked up—i.e., when its contacts vr_1–vr_3 still occupy the position shown in FIGURE 6—it is possible by depressing the correcting button 22 to open the contact 96 and thus to interrupt the circuit of the holding relay HR; in this case, the contacts hr_1 and hr_2 of the said relay return to the position shown, so that the transformer 77, the units 41 and 42, the fluorescent tube 26 of the transformer 98, the starting relay ST and the actuating device 89 become de-energised, and the holding relay HT furthermore remains unenergised even when the correcting button 22 is released.

Since the coin holding solenoid 52 likewise becomes de-energised owing to the transformer 77 being cut out, the blocking element 50 fitted to the armature 51 of the former returns into the clearing position, and coins present in the channels 45 and 65 fall through the apertures 46 and the channel 49 into the return cup 21, because the coin deflector solenoid 56 is not energised, and consequently the deflecting pin 54 occupies the position 54'. It is now possible to correct the programme selection, or any items of linen unsuited to the programme selected may be removed again from the washing drum.

A few seconds after the closure of the switch 40, and the picking up of the interlocking relay VR thereby caused and explained hereinbefore, the switch 39 is opened by the nut 34, whereby the coin deflector solenoid 56 is de-energised. If coins are inserted into the slots 19 and 20 during the programme cycle, they therefore fall immediately into the return cup 21.

Finally, when the programme has been performed, the punched-card-controlled relay R10 picks up and causes the relay contact *r*10 to transit, whereby on the one hand the supply of current to the actuating device 89 and to the holding relay HR is interrupted, and on the other hand the restoring relay RR becomes energised in the circuit 74, 78, *r*10, RR, 79, 75, and then holds itself via its contact rr_3. The contact rr_1 is opened, and therefore prevents re-establishment of the current supply to the actuating device 89 and to the holding relay HR when the relay R10 drops.

The transiting of the contact rr_2 has the result that the phase displacement between the two currents flowing through the motor 37 in the current branches 92, 95 and 83, 95 reverses the direction of rotation of the rotary field generated by the said currents—that is to say, the direction of rotation of the motor 37. The screw-threaded spindle 35 is now driven rapidly in the reverse direction by the gear 36, so that the pickup head 29 returns rapidly to its original position. Shortly before the end of this restoring movement of the pickup head 29, the nut 34 closes the switch 39 and—immediately afterwards—opens the switch 40. The current supply to the motor 37, which had been effected, after dropping of the relay ST, via the said switch 40 and the contact st_1 occupying its normal position, is thereby interrupted, so that the motor 37 runs down, while the pickup head 29 comes back into the original position. Simultaneously, the current supply to the restoring relay RR is also interrupted, so that the latter drops, whereby the original position of all the contacts, shown in FIGURE 6, is established once more.

After the clean laundry has been removed from the washing drum, the washing machine is now available to perform a fresh washing programme.

It is not absolutely necessary for all the control circuits of the actuating device 89 to be switched under the influence of the pickup head 29 by the relays R6–R10 of the unit 42, as the case of the exemplary embodiment described. It is also possible, for example, to actuate a further switch, in addition to the switch 18, by rotation of the drum 6, and to exercise certain control functions by the said switch—e.g., to switch an actuating element on permanently in the case of certain programmes, and to switch the said actuating element off permanently in the case of other programmes. In this manner, it is possible in some circumstances to economise one line provided with slots on the punched cards, and thereby on the one hand to reduce the size of the drum 6 and on the other hand to render one photo-resistance in the pickup head 29 and one amplifier and one relay in the unit 42 superfluous. Such an additional switch coupled to the shaft 13 or incorporated in the switch 18 may of course also be provided if punched cards 7 exhibit five lines as in the case of the embodiment described, a greater or smaller number of lines.

It is obvious that the coin box 48 is provided with a lock. Indeed, two locks are preferably provided: a first lock, after the opening of which the coin box can be detached from the machine housing 1, and a second lock,

which serves to seal the coin box itself. In this case, the key of the first lock may be entrusted to a messenger boy, whose duty is merely to collect the coin boxes, and the key of the second lock to a trusted person—e.g. a cashier of a bank.

Although, in the embodiment described, the fluorescent tube 26 mounted in the interior of the punched card drum 6 is stationary, the same might also be rotatable together with the actual drum 6. But in the event that a reflector 27 is used, this must be stationary in order to reflect the light originating from the tube 26 constantly onto the selected punched card 7 which has been brought into the reading position between the pickup head 29 and the said tube 26.

I claim:

1. An automatic washing machine, more particularly for self-service laundries, having a device adapted to be controlled by a punched card and actuating the elements of the machine required to be actuated in order to perform a washing programme, while the punched card is provided with holes arranged in rows which determine the washing programme, characterised by a rotatable prismatic drum, the sides of which are formed by punched cards corresponding to various washing programmes and which is connected to a setting element whereby the required punched card can be brought between a pickup head and a light source mounted in the interior of the punched card drum; by photosensitive elements provided in the pickup head and associated with the lines of the punched card, which—via amplifiers—control relays in an electric circuit, the contacts of which in turn control the actuating device; by a coin receiving device; by a comparative circuit device which compares the setting of the punched card drum with the amount paid by insertion of coins into the coin receiving device and, in case the payment is sufficient for the price of the washing programme selected, establishes an electrical connection, the establishment of which is necessary for the automatic performance of the washing programme corresponding to the selected punched card.

2. A washing machine as claimed in claim 1, characterised in that the comparative circuit device embraces a logical circuit constructed of electrical contacts which exhibits an input terminal and as many output terminals as the drum has punched cards, while the said contacts are controlled by the coins inserted into the coin receiving device in such manner that when coins sufficient for the price of a washing programme are inserted the said input terminal becomes connected to an output terminal associated with the said programme, and that the comparative circuit device further embraces a selector switch which exhibits an input terminal and the same number of output terminals each connected to one of the aforesaid output terminals, so that in each setting corresponding to the selection of a specific punched card a contact arm of the selector switch connects its input terminal to one of its output terminals and hence also to the input terminal of the logical circuit, in the event that coins sufficient for the price of the programme set have been inserted into the coin receiving device.

3. A washing machine as claimed in claim 2, characterised in that the contacts of the logical circuit belong to relays which are controlled via amplifiers by photosensitive elements in terms of the presence or absence of coins in or from channels inclined to the horizontal which are present in the coin receiving device, at points located between a light source and the said photo-sensitive elements.

4. A washing machine as claimed in claim 3, characterised in that at the lower end of two inclined channels intended to be charged with coins via insertion slots there is provided a blocking element which is fitted to the armature of a coin holding solenoid in such manner that the blocking element blocks the outlet of the channels when the said solenoid is energised, but clears the same when the said solenoid is unenergised.

5. A washing machine as claimed in claim 4, characterised in that beneath the blocking element is mounted a deflecting element which is fitted to the armature of a coin deflecting solenoid in such manner that the said deflecting element deflects coins which fall out of the cleared outlet of the channels towards a coin box when the said solenoid is energised, but towards a return cup when the said solenoid is unenergised.

6. A washing machine as claimed in claim 4, characterised in that immediately behind the insertion slots means are provided in order, when a coin is inserted into one or the other slot, briefly to short-circuit a switch which, when main voltage is present at the input terminals of a programme selection and control circuit, causes the circuits necessary for the operation of all the photosensitive elements to which reference has been made and associated amplifiers and relays to be completed, and voltage is applied to the comparative circuit device, so that in the case of sufficient payment a current flows through the same and triggers the series of control operations.

7. A washing machine as claimed in claim 6, characterised in that the programme selection control circuit exhibits a holding relay which becomes energised when the insertion switch is briefly closed and is self-holding via one of its contacts, and that when a current flows through the comparative circuit device a starting relay becomes energised which, via one of its contacts, applies voltage to a motor which serves to move the pickup head.

8. A washing machine as claimed in claim 7, characterized in that shortly after the commencement of the movement of the pickup head from its original position by an element serving to drive the same, a switch is closed with the result that an interlocking relay becomes energised, by the contacts of which interlocks are actuated directly or indirectly in such manner that up to the expiration of the programme set no variations of any kind to the setting of the machine can be performed, and also it is no longer possible to open its door which serves for charging and removing the laundry.

9. A washing machine as claimed in claim 8, characterised in that a correcting button is provided whereby it is possible, before the interlocking relay has picked up, to open a contact provided in the circuit of the holding relay so that the latter relay drops, which causes the coins inserted into the coin receiving device to fall out into the return cup and enables another programme to be selected.

10. A washing machine as claimed in claim 7, characterised in that the motor which serves to move the pickup head is a reversible synchronous motor which drives—via a reduction gear—a screw-threaded spindle on which is mounted a nut supporting the pickup head, while the spindle is driven slowly when the motor rotates in the direction corresponding to the reading of the punched card, but rapidly when the motor rotates in the opposite direction.

11. A washing machine as claimed in claim 7, characterised in that one of the relays controlled from the punched card which becomes energised at the conclusion of the programme exhibits a contact via which, after the said relay picks up, a restoring relay becomes energised which—by the transition of one of its contacts—reverses the direction of rotation of the motor, so that the latter restores the pickup head rapidly into its initial position, while before the said initial position is reached the element referred to which serves to drive the pickup head reopens the switch which it had closed shortly after the commencement of the movement of the pickup head from its initial position, and that the other contacts initiate the restoration of the entire programme selection and control circuit (FIGURE 6) into the initial position.

12. A washing machine as claimed in claim 1, characterised in that the punched card drum and the coin receiving device are accommodated in a subsidiary housing which is erected upon the cover of the washing machine

housing and is provided with a faceplate which exhibits a window through which the selected punched card of the drum is visible and which further exhibits slots for the insertion of coins into the coin receiving device.

13. A washing machine as claimed in claim 12, characterised by two assembly units accommodated in the subsidiary housing, whereof the one contains the amplifiers and the relays which are controlled by the photo-sensitive elements formed by photo-resistances contained in the pickup head, whereas the other assembly unit contains the amplifiers and relays which are controlled by the photo-

sensitive elements, likewise formed by photo-resistances, which are present in the coin receiving device.

14. A washing machine as claimed in claim 12, characterised that in the vicinity of the coin insertion slots there is mounted an indicating device which embraces an indicator lamp, the illumination of which indicates that the electrical connection has been established in the comparative circu't device.

No references cited.