

[72] Inventor Wilhelm Eppers
 St. Georgen, Black Forest, Germany

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[73] Assignee Math. Bauerle GmbH
 St. Georgen, Black Forest, Germany

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[33] Germany

[31] 1,411,018

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Primary Examiner—Robert W. Michell
Assistant Examiner—Paul V. Williams
Attorney—Spencer & Kaye

[54] COLLATING MACHINE
 11 Claims, 9 Drawing Figs.

[52] U.S. Cl..... 270/58

[51] Int. Cl..... B65h 39/02

[50] Field of Search..... 270/54, 58

ABSTRACT: A machine for collating sheets of paper. A photoelectric-sensing device determines whether more than one type of a sheet has been fed, while a spring contact sliding against a roller determines the absence of a sheet. If either more than one sheet is sensed or the absence of a sheet is detected, an electrical path is closed by a cam operated by movement of the conveyor of the machine. This closing shuts down the conveyor and a machine operator can then correct the sensed problem.

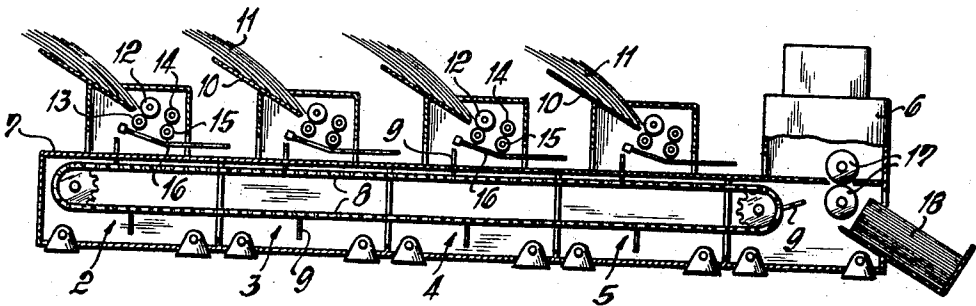


FIG. 1

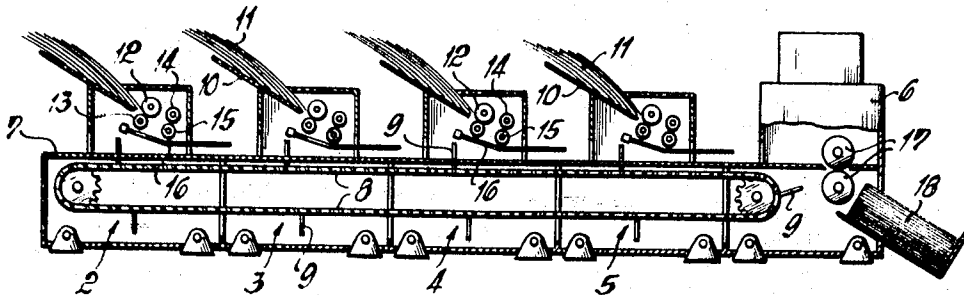
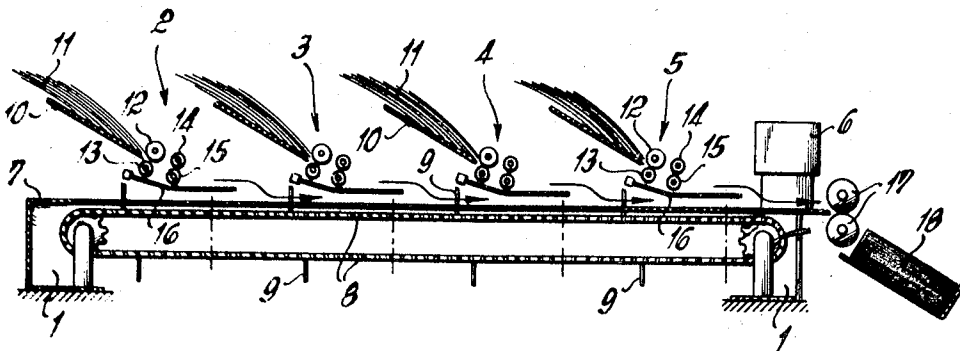


FIG. 2



INVENTOR
WILHELM TIEPERS
by Jacob L. KOLLIN
ATTORNEY

FIG. 3

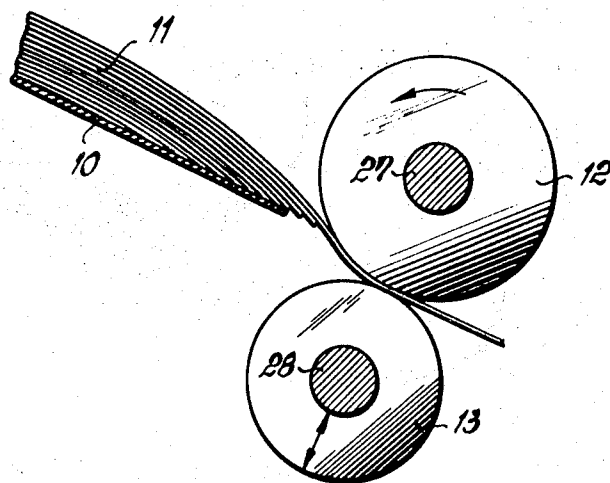
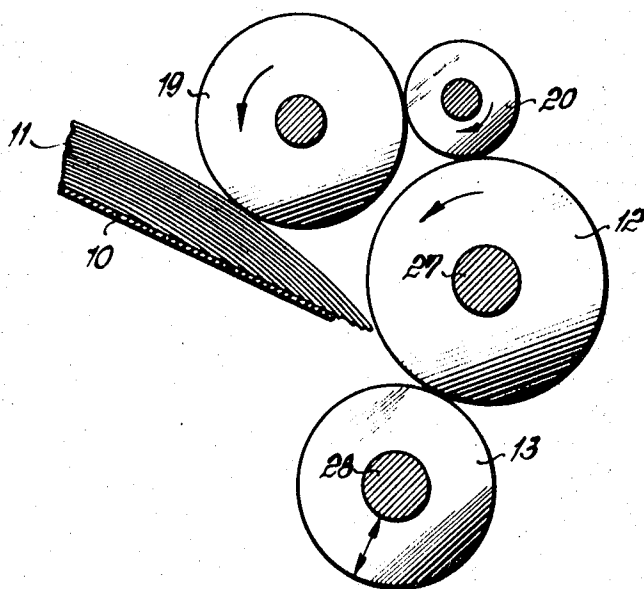


FIG. 4



INVENTOR
WILHELM EPPERS
by Jacob L. KOLLIN
ATTORNEY

FIG. 7

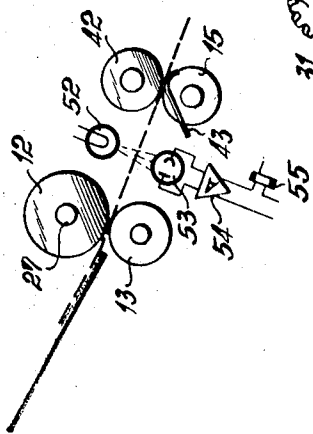
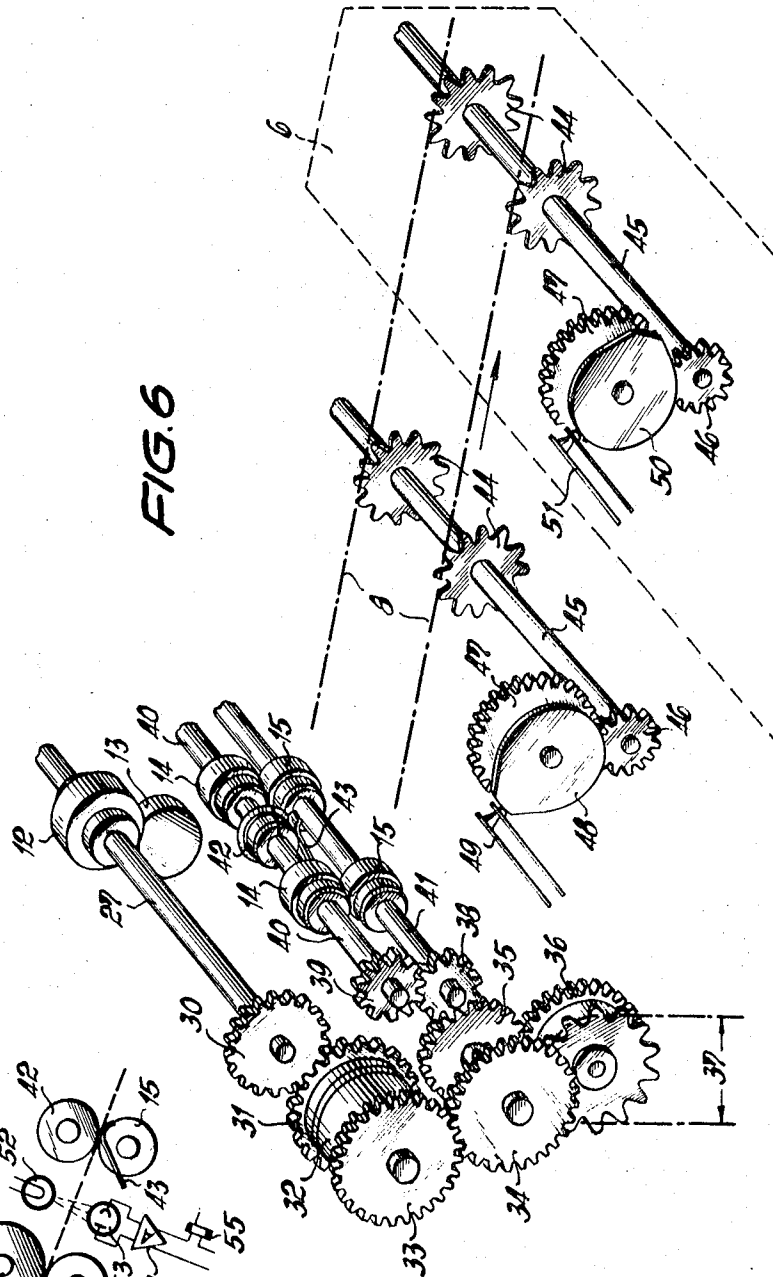


FIG. 6



INVENTOR
WILHELM EPPER,
by Jacob L. Kollin
ATTORNEY

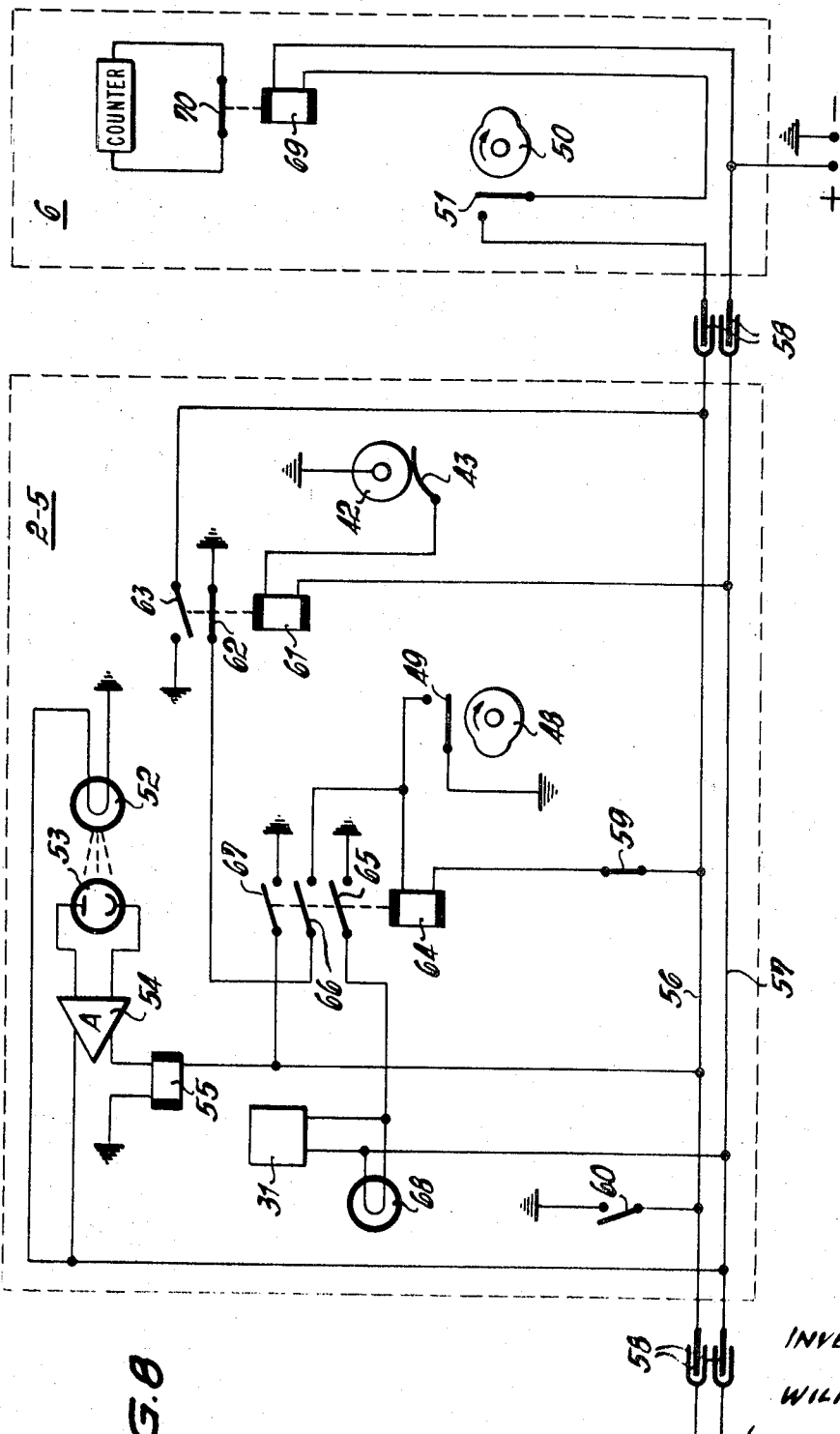


FIG. 8

INVENTOR
WILHELM EPPER'S
by
Jacob H. KOLLIN
ATTORNEY

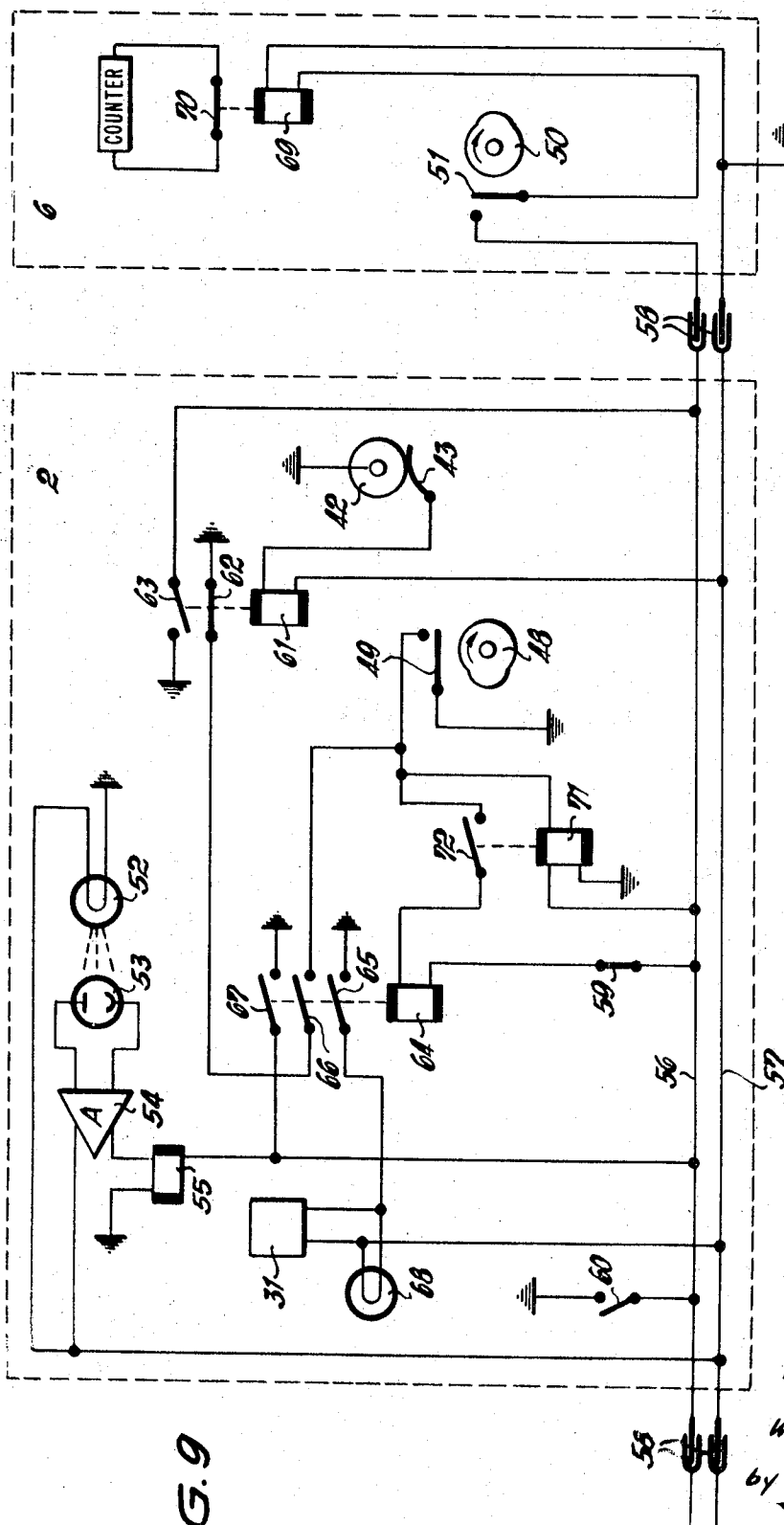


FIG. 9

INVENTOR
WILHELM EPPERS
by *Joseph L. Rollin*
ATTORNEY

COLLATING MACHINE

This application is a continuation of copending application Ser. No. 233,854, filed Oct. 29, 1962, now abandoned.

The invention relates to a collating machine i.e. to a machine in which sheets of different kinds, e.g. of different colors, different thicknesses, different formats, different im-

printing, are to be assembled in sets. By way of example the present invention is concerned with prospectus sheets, forms, brochures and copy sets with various consecutive sheets arranged one on top of another.

Collating machines of this kind are known in many forms. Such machines are mostly of considerably complicated construction, and their manufacture and installation presents considerable difficulties.

Devices are also known which stop the machines or at least provide a signal when a sheet is lacking and also when more than one sheet is inserted. These depend principally on mechanical thickness measurement and are therefore greatly influenced by machine speeds so that they are not foolproof when thin paper is employed.

SUMMARY OF THE INVENTION

The object of the invention is to provide a machine of the above character which is constructed in a conceivably simple manner, which assures production which operates continuously without interruption because of the refilling of magazines, and which assures the maintenance of a fast, uniform working cycle with a loading of only one sheet of a given type at a time.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims taken in conjunction with the accompanying drawings.

It should be understood, however, that these are given by way of illustration and not of limitation, and that various changes in the details, form and arrangement of the parts may be made without departing from the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic representation of the assembly system of the machine;

FIG. 2 is a schematic overall representation of an assembly machine;

FIG. 3 is an enlarged schematic representation of the feed rolls with its respective paper stack;

FIG. 4 is a view similar to that of FIG. 3 with the addition of a feed device;

FIG. 5 is a partly modified form of a feed station;

FIG. 6 is an extended view of the driving connections of the loading aggregate as well as of the control elements for controlling the cycles;

FIG. 7 is a schematic perspective view of the device for stopping the loading of less than one or more than one sheet;

FIG. 8 is a wiring diagram for a loading station and the end station; and

FIG. 9 is a similar diagram to that of FIG. 8 with the addition of a metering relay.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in detail, the collating machine comprises a frame 1 which consists of a row of similar frame parts containing loading stations or devices 2, 3, 4, 5, and an end part 6, which houses the drive part and the control means which are common to all stations. The frame 1 is provided with cover plate 7 which consists of a number of smooth plate parts provided with longitudinal slots extending therethrough, said plate parts corresponding in number to that of the stations. A pair of chains 8 extend under the cover plate 7 and to these are secured transversely and outwardly directed carriers 9 which extend through the longitudinal slots of the cover plate 7 and are slidably displaceable on the sheets loaded on plate 7.

Each loading station is equipped with a loading unit which is disposed above the cover plate 7. Each of these units com-

prises a fixed loading table 10 for receiving fanned multiple-sheet stacks, a pair of friction feed rollers 12, 13, forwarding rollers 14, 15, as well as a cantilevered grate associated therewith not shown. This grate is needed only when loading thin and/or short sheets and is therefore detachably secured. The end portion 6 is equipped with delivery roll pairs 17, which carry forward to a stacking device 18 the sheets delivered on the cover plate 7 by the chains 8 and their carriers 9. The sheets are arranged in stacks during their transport.

As more clearly shown in FIG. 2, obliquely downwardly directed sheets of the stack 11, grasped by the feed rollers 12, 13, are laid, in the direction of the arrow, upon the upper surface of the cover plate by means of forwarding rollers 14, 15 and the grate 16. There they are grasped by the carriers 9 and are moved under the feed aggregate of the next station. The feed rhythm is so arranged that the sheet fed from the next station falls upon the sheets which were fed from the previous station. After the last loading station all the sheets are lying on one another in the proper sequence and are then forwarded in sets from the delivery roll pairs 17 to the stacking device 18.

As shown in FIG. 3, the friction feed rollers 12, 13, grasp, each time, the uppermost sheet of the fan-shaped sheet stack 11 on the table 10 and forward it obliquely downwards. To assure the grasping of the uppermost sheet, there are provided special feeders of known construction, as shown schematically in FIG. 4. These feeders comprise a resiliently pressing separator roller 19 disposed against the uppermost sheet. Roller 19 is driven by the upper feed rollers 12 by means of intermediately engaging friction wheel 20.

As shown in FIG. 5, the carriers connected with the conveyor chains 8 are advantageously constructed as upwardly extending members 21. These members comprise upwardly extending rods 22, which terminate in upper, forwardly directed, angles 23. These angles reach over the trailing edges of the sheets which are to be moved and prevent the sheets from slipping backwards over the carriers, should the sheets curve. There are further secured to fixed transverse rods 24 horizontal stop rods 25, in such a manner that the lower edges of rods 25 are disposed under the lower edges of the angles 23, to assure that the sheets grasped at their trailing edges and arranged by the carriers 22, 23 lie flat on the grate 16 and are guided along the grate without deformation.

It should also be noted, that in the friction feeders, only the upper friction roller 12, operatively connected with a drive shaft 27 through a pawl lock 26, effects the further movement of the sheets delivered by the feeder rolls 19, while the lower friction roller 13, which is nonrotatably secured on its shaft 28 and which is adjustable together with said shaft relative to the drive roller 12 for each sheet thickness guides the sheets into the contact between the forwarding rollers 14, 15 and extends through curved guide plates 29.

In FIGS. 6 and 7 are shown the already described parts and the particular control means for cyclic movement of the feeder rolls and for the control of the correct feeding of each sheet. The drive shaft 27 of the upper drive roller 12 is drivingly connected through a gear 30 with the electrically controllable part 31 of an electromagnetic coupling, the constantly running part 32 whereof is in driving connection with a constantly running chain drive 37. The gear 35 drives, by means of meshing gears 38, 39, both of the shafts 40, 41 which are fixedly connected with the forwarding rollers 14, 15.

A contact roller 42 is mounted on the upper shaft 40 between two conveyor rollers 14, said contact roller 42 having the same diameter as the conveyor rollers 14, 15. A contact spring 43 bears against the contact roller 42.

Meshing with the conveyor chains 8 are two chain wheels 44, the shafts 45 of which drive via gears 46 and 47 cam discs. The cam disc 48 actuates a microswitch 49 once during each revolution.

In the end portion 6, shown by a dotted outline, cam disc 50 is driven by conveyor chains 8 through a similar drive connection. The cam of the cam disc 50 is offset about 90° behind,

relative to the cam of cam disc 48, and actuates a microswitch 51.

Between the drive rollers 12, 13 and the forwarding roller pairs 14, 15 there is disposed a photoelectric control device (FIG. 7) which to transilluminates the passing sheets relative serves to control the number of sheets. The photoelectric control device is provided with a lamp 52 of an adjustable light intensity, a photodiode, 53 prevent an amplifier 54 and a relay switch 55.

One of the relay switching arrangements in the above-described part will be next described in connection with FIG. 8. In this FIG. the circuitry which is used in a similar manner at each of the loading stations 2 to 5, is encircled on the left by a dotted line, while the portion on the right, encircled by another dotted line, contains the circuitry for the end portion 6.

All of the stations, according to this embodiment are provided with a pair of common control lines 56, 57 of which line 56 receives the control impulses and line 57 is connected to the positive terminal of a current source. The parts of lines 56, 57 in the loading stations are connected between loading stations by means of plug connections 58. A manually operated switch 59 e.g. a toggle switch which is closed during operation serves to switch on and off each loading station individually, while a similar switch 60, open during operation, makes it possible for an operation standing at any of the stations to stop the conveyor.

The contact roller 42 and its sliding contact spring 43 actuate a relay 61 which is provided with an operating contact pair 62 and an idling contact pair 63. One side of the microswitch 49 of the cam disc 48 is connected to ground (negative) while the other side is connected to a relay 64. Relay 64 is connected to the positive line 57 through the manual switch 59 and is provided with three operating contact pairs 65, 66, 67. Parallely to the microswitch 49 there is arranged in series the operating contact pair 66 of the relay 64 and the operating contact pair 62 associated with the relay 61. The fixed contact of operating contact pair 62 is grounded. The fixed contact of the idling contact pair 63 of relay 61 is likewise grounded and its movable contact is connected with the control line 56. The contact pair 65 of the relay 64 has one side grounded and its other side connected to the positive line 57 through the controllable part 31 of the electromagnetic coupling and through an indicator lamp 68 connected in parallel with part 31. The operating contact pair 67 is arranged between ground and the control line 56. The photoelectric-testing device which serves to control the number of sheets, is connected with one side to the control line 56 and with another side with the current feeding control line. 57.

The microswitch 51 of the cam disc 50 is connected with one side with the end of the control line 56 and with its other side with a closed circuit relay 69, the contact pair 70 of which controls a clutch in the drive of conveyor chains 8.

The manner of operation will be described beginning with the condition of the circuit shown in the diagram. The conveyor chains 8 are moving, since the contacts 70 are closed. The movable coupling half, controllable part 31, and its indicator lamp 68 are not connected, so that the loading stations are not feeding any sheets at this instant. The sliding contact spring 43 is in abutment with the contact roller 42, whereby the corresponding relay 61 is energized and maintains its operating contact pair 62 closed and its idling contact pair 63 open.

As the cam disc 48 actuates its switch 49, during its rotation in the indicated rotational sense, the relay 64 is energized and closes its contact pairs 65, 66 and 67. The contact pair 65 energizes the coupling half 31 while simultaneously lighting the lamp 68. The friction rollers 12, 13 are set into operation feed and upper sheets between the constantly turning forwarding rollers 14, 15 and simultaneously between the contact 42 and the sliding contact 43. By the time the contact roller 42 and a sliding contact 43 are separated by the sheet passing between them, the cam disc 48 will have turned further and

will have opened the switch 49. The relay 64 at first remains in its operating position since the relay holds itself by means of its own contact pair 66 and the still closed contact pair 62. As one of the sheets advanced by the friction rollers 12, 13, separates the sliding contact 43 from the contact roller 42, the relay 61 is deenergized, its contact pair 62 is opened and its contact pair 63 is closed.

The relay 64, which has been holding until now, is deenergized and releases the coupling half 31. The friction rollers 12, 13 come to a standstill, while the forwarding rollers 14, 15, continue to move the sheets forward. The closing of the contact pair 63 grounds the control line 56 and thus provides a current circuit for the relay 69 through switch 51 of the cam disc 50. Should the rear edge of the delivered sheet pass between the contact roller 42 and the sliding contact 43 before the cam of cam disc 50 has actuated the switch 51, then the reenergized relay 61 keeps open the previously mentioned current circuit of the relay 69, by opening its idling contact pairs 63.

The described operation is repeated as long as the sheets are grasped by the friction rollers 14, 15 within a certain time and are moved further along.

Should, however, the drive roller 12 not deliver a sheet to the contact roller 42 within a period corresponding to the working cycle and thus fail to separate the contact roller from the contact spring 43, then the relay 61 remains energized, the self-holding circuit of the relay 64 remains closed and its operating contact pair 67 keeps the control line 56 grounded. Since after a predetermines time lapse, which is dependent on the position of the cam of the cam disc 50 relative to the position of the cam of the cam disc 48, the switch 51 controlled thereby is closed, and if until then no sheet is advanced and has not passed the contact spring 43 at the appropriate time, the relay 69 is opened and interrupts, through its contacts 70, the coupling current circuit of the chain drive.

An entirely similar effect taken place, when the photoelectric inspection device 52-55 ascertains the passage of more than one sheet due to the obstruction of the light rays passing through the sheet. In such a case too, the control line 56 is grounded through relay switch 55, and the cam disc 50 then effects the stoppage of the motor drive.

It should be noted at this point, that when a sheet fails to be fed from stack 11, the chains 8 will be detained, but the drive rollers 12 and the forwarding rollers 14, 15 continue to rotate. Should now a sheet advance, then the relay 61 is deenergized due to the lifting of the sliding contact 43, so that it interrupts the holding current circuit of relay 64. This disconnects the coupling 31 through the contact pair 65 and stops the drive shaft 27 of the drive roller 12. The forwarding rollers 14, 15 continue their rotation and advance the delayedly introduced sheet to the cover plate 7. The conveyors are again placed in operation by the opening of the contact pair 63 and switch 51 energizing circuit of the relay 69.

Thus, through a corresponding arrangement of the carriers 9 relative to the forwarding rollers 14, 15 and the cam of the cam disc 50, the conveyor chains 8 and their carriers 9 are assured of remaining in a position in which the delayedly delivered sheets are loaded before the carriers 9.

The switching sequence taking place in case of a delayed passage of a sheet will be explained in more detail. Should the leading edge of the sheet separate the sliding contact 43 from the contact roller 42, then the relay 64 is deenergized and stops the drive shaft 27 of the drive roller 12, by opening its contact pair 65. Simultaneously it also opens, besides its stop contact pair 66, the contact pair 67 and thereby separates the control line 56 from ground. The conveyor chains 8 can therefore continue their movement. The energized relay 61 has, however, provided a connection between the control line 56 and ground through its idling contacts 63 and maintains this connection until the rearward edge of the passing sheet has passed the contact position between the contact roller 42 and the contact spring 43. Only when this has taken place, does the relay 61 become energized again and opens its idler contact

63. The conveyor chains 8 can therefore run further only when the rearward edges of the delivered sheet have passed the contact roller 42 and thereby the conveyor roller 14. 15 and are disposed in the right position before the carriers 9.

When more than one sheet is advanced, as ascertained by the photoelectric inspection device, the control line 56 is also grounded and the conveyor chains 8 remain in the same position as in previously discussed interruptions. The sheets reach the grate 16 and the excess of the delivered sheets can be removed. The connection provided by the relay 55 between the control wire 56 and the ground is maintained until a push button switch (not shown) interrupts the self-support of the switch member 55.

The circuit shown in FIG. 9 relates to a loading station, which serves to control the number of assembled sets of sheets belonging together, and can therefore be arranged before the first or behind the last of the previously discussed loading stations. It is its primary purpose to count the number of set groups containing a certain quantity of sets pertaining, e.g., to a copying book. Finally these groups of sets are separated from one another by inserting interleaving sheets.

The counting station corresponds to the above-described loading stations until one considers the counting equipment. The photoelectric control device can usually be switched off, since ordinarily the interleaving sheets to be inserted are practically impenetrable by light, and because, after a certain interleaving sheet thickness, there is no danger that a plurality of interleaving sheets would be delivered.

The essential difference resides in the fact that a counting relay 71, controlled by electrical impulses, is connected between the relay 64 and the switch 49. This counting relay is provided with a contact 72 in the energizing line of the relay 64, which closes after a predetermined, adjustable number of impulses, i.e. after a number of inserted sets has passed by, and connects the coupling 31 of the advancing unit for the heavy or cardboard interleaving sheets. The relay 71 opens automatically its contact 72 after the passage of an interleaving sheet. The timely passage of the interleaving sheet to be inserted is controlled in this case exactly as in the case of the remaining insertion stations.

I claim:

1. A machine for collating sheets of paper from a plurality of stations to form sets comprising, in combination:

a plurality of inclined tables for supporting stacks of identical sheets, provided close to a conveyor which transports sets of collated sheets, each of the tables being provided with a feeding roller means adapted to withdraw the uppermost sheet of the stack and to drop it down onto the conveyor, at least some of the tables having a first sensing means for detecting feeding of more than a single sheet and formed as a photoelectric device, and a second sensing means for detecting failure to feed a sheet and formed as a contact roller and an associated sliding contact bearing against the contact roller and adapted to be disengaged therefrom by a delivered sheet passing between the contact roller and the sliding contact; and

at least one conveyor-operated switch means for opening and closing a line, and coupling means for coupling said conveyor-operated switch means to said conveyor for intermittently operating said conveyor-operated switch means upon movement of the conveyor;

further switch means operated by the first and second sensing means being effective to establish a connection upon no sheet or more than a single sheet being delivered by a said feeding roller means, and means for utilizing

said connection for effecting stoppages of the conveyor upon subsequent operation of said conveyor-operated switch means.

2. A machine according to claim 1, further comprising a second conveyor-operated switch means for turning said feeding roller means on and coupling means for coupling said second conveyor-operated switch means to said conveyor for intermittently operating said second conveyor-operated switch means upon movement of the conveyor, both coupling means including rotatable cam discs, the cams of the cam discs being angularly displaced relatively to each other, so that the second conveyor-operated switch means operates a determined period in the cycle of the machine before the first-recited conveyor-operated switch means whereby the conveyor continues to move for an interval after the feeding roller means is on, even though the second sensing means has sensed that a sheet has not been fed.

3. A machine according to claim 2, the feeding roller means of each table including a feeding roller, a drive shaft carrying the feeding roller, and an electromagnetic coupling means for coupling the drive shaft to a source of mechanical power, which electromagnetic coupling means is controlled by an electrical circuit including said sensing means and the conveyor-operated switch means controlled by the cam discs.

4. A machine according to claim 3, in which the contact roller, against which the sliding contact bears, is coupled to a relay having a normally open switch which lies in a holding circuit of a further relay adapted to be operated by said second conveyor-operated switch means, a contact of the further relay being electrically connected to the electromagnetic coupling means and another contact of the further relay being connected with the first sensing device.

5. A machine according to claim 1, said feeding roller means including a separator roller resiliently abutting the uppermost sheet of each stack, a feed roller, and a friction wheel, the separator roller being driven by its feed roller by means of frictional contact of the friction wheel with the separator roller and the feed roller.

6. A machine according to claim 1, further comprising forwarding rollers positioned adjacent the feeding roller means, the sheet fed by the feeding roller means passing through the forwarding rollers and onto the conveyor.

7. A machine according to claim 4, in which the relay, the further relay, the electromagnetic coupling means, and a relay in said means for utilizing are connected to an electrical supply source and through at least one more switch to ground.

8. A machine according to claim 7, in which the relay in said means for utilizing and the first-recited conveyor-operated switch means are provided in an end station, a groundable control line and a power supply line being common to all stations, the groundable control line including the first-recited conveyor-operated switch means.

9. A machine according to claim 8, in which the groundable control line and the power supply line which are common to all stations are interconnected by plug-and-socket connections.

10. A machine according to claim 1, in which the stations are provided with hand-operated switches by which the feeding roller means and the conveyor respectively may be switched on or off.

11. A machine according to claim 1, in which the first or the last station is provided with a counting relay means, operated by electric pulses generated in dependence on the sheets which are delivered, for causing the feeding of interleaving sheets after delivery of all the sheets belonging to a set.