United States Patent [19]

Flad

[11] **3,724,240**

[45] **Apr. 3, 1973**

[54] KNITTING MACHINE WITH DEVICE FOR JACQUARD PATTERNING

[76] Inventor: **Karl Flad,** 29 Haupstrasse, Undingen, Germany

[22] Filed: **Nov. 12, 1970**

[21] Appl. No.: **88,545**

[30] **Foreign Application Priority Data**

Nov. 14, 1969 Germany ..... P 19 57 399.0

[52] **U.S. Cl.** ..... **66/50 R,** 66/50 B

[51] **Int. Cl.** **D04b 15/78**

[58] **Field of Search** ..... 66/50 R, 25, 154 A, 75, 50 B

[56] **References Cited**

UNITED STATES PATENTS

3,423,960	1/1969	Wiesinger et al.	66/25
3,446,037	5/1969	Sutton	66/25
3,564,870	2/1971	Glaunsinger	66/50 R
3,262,285	7/1966	Beguin et al.	66/50 R
2,173,488	9/1939	Tandler et al.	66/50 R
3,229,482	1/1966	Farmer	66/50 R
2,731,817	1/1956	Thurston	66/50 R X
3,274,802	9/1966	Schmidt et al.	66/154 A X
2,970,461	2/1961	Hoffman	66/154 A UX
2,072,969	3/1937	Tandler	66/154 A

FOREIGN PATENTS OR APPLICATIONS

483,511	2/1970	Switzerland	66/50
1,563,200	3/1969	France	66/50 R
336,151	10/1930	Great Britain	66/50 R
164,914	8/1965	U.S.S.R.	66/75

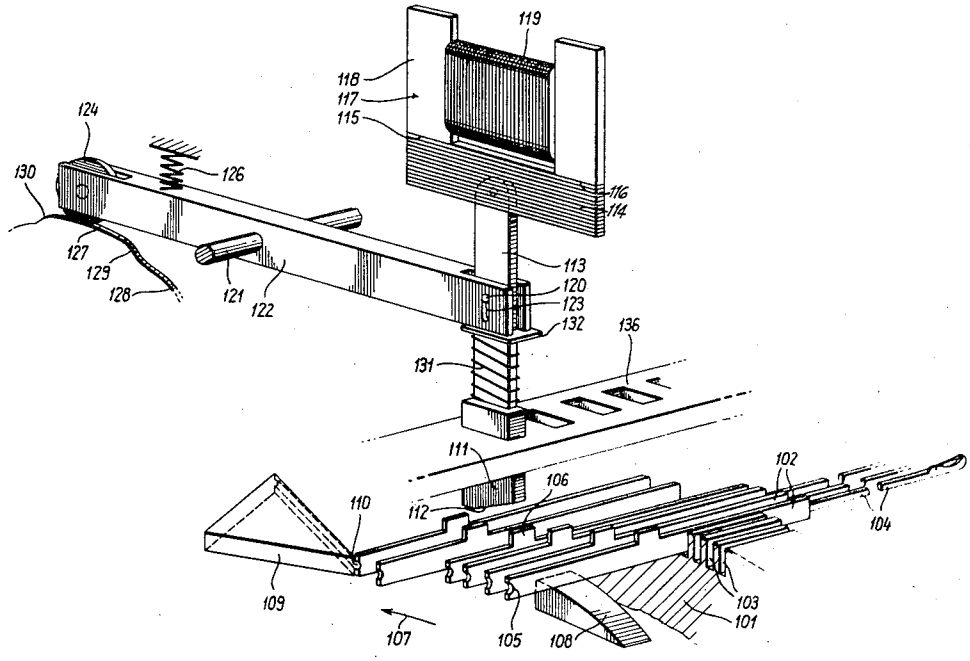
Primary Examiner—Wm. Carter Reynolds

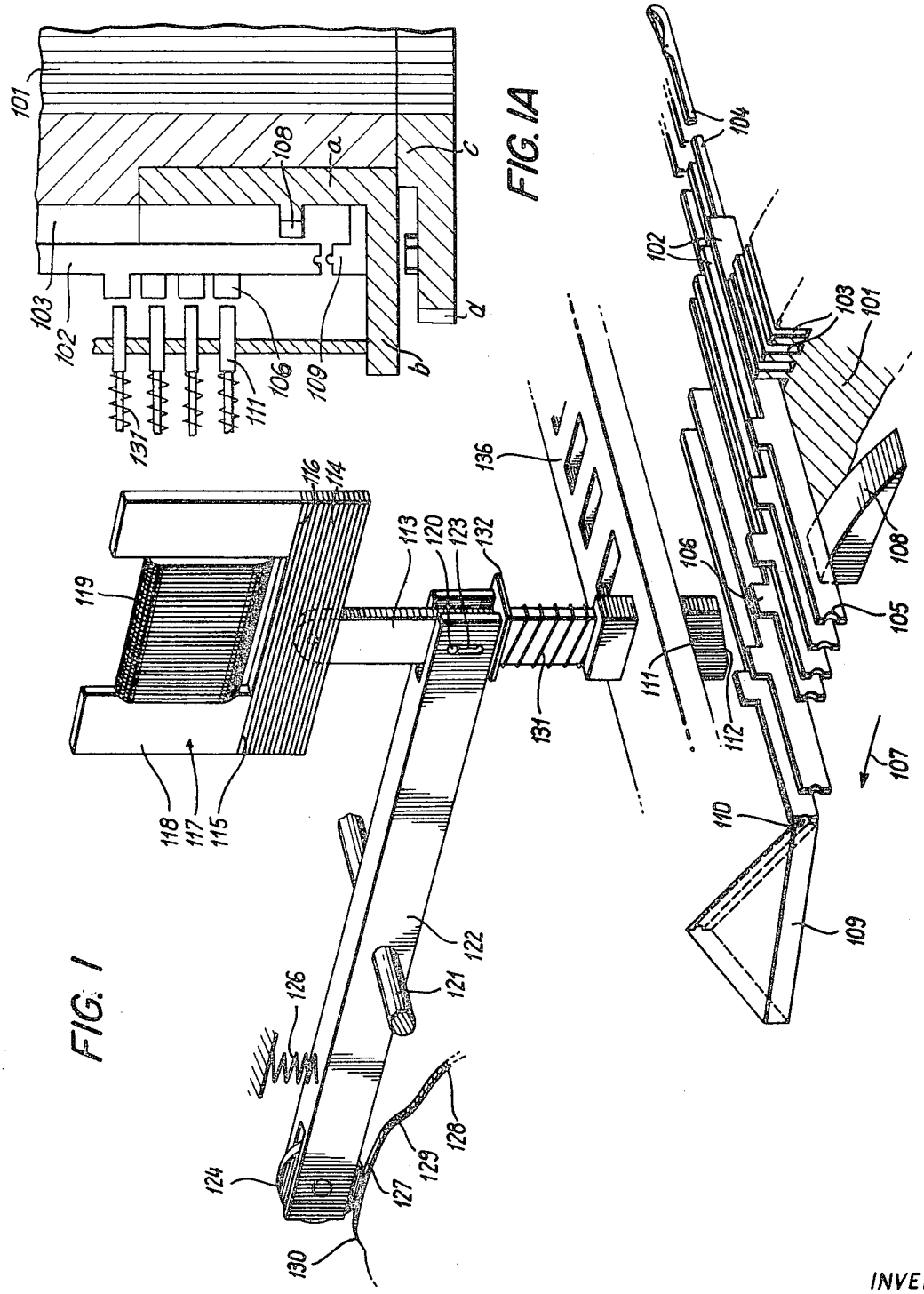
Attorney—Craig, Antonelli & Hill

[57] **ABSTRACT**

A knitting machine is provided with a device for Jacquard patterning which comprises a read-out device for information relating to a desired pattern, wherein the read-out information is arranged to control electromagnets which in turn set displaceable parts, such as jacks or plates, into an operative position in which they can actuate needles associated therewith, or into a rest position, in which they can miss the needles. For this purpose each electromagnet is arranged to control the position of a guide face, and each guide face is arranged to control a group of parts during relative movement between the guide faces and the groups. The parts of a group are separated from each other by the parts of other groups, and are of a number which is smaller by one than the number of electromagnets. The guide faces are staggered is a row transverse to the direction of relative movement and co-operate with control faces which are disposed on the parts at correspondingly staggered locations. The invention is adaptable for use in flat bed knitting machines and circular knitting machines. A mechanical cam disc controls a pivot arm which has an end opposite the control disc in engagement with a member directly controlling a slide member so that such slide member may be moved in one position by said electro-magnetic means only when said cam is in a certain predetermined range of rotation. The slider member has a lower end comprising the guide face for directly engaging the control faces which are provided on the jacks or plates, which jacks or plates in turn directly engage the knitting needles.

10 Claims, 7 Drawing Figures





INVENTOR

KARL FLAD

BY Craig, Antonelli, Stewart & Hill

ATTORNEYS

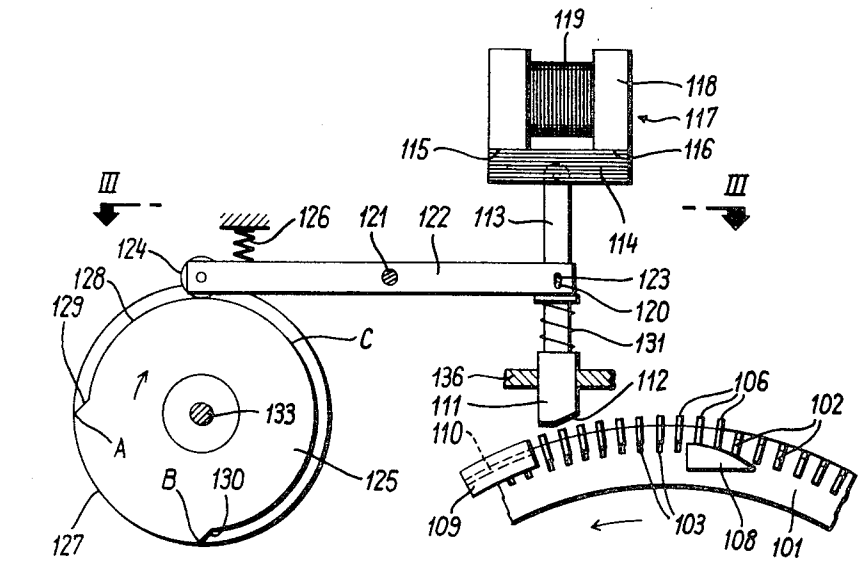


Fig. 2

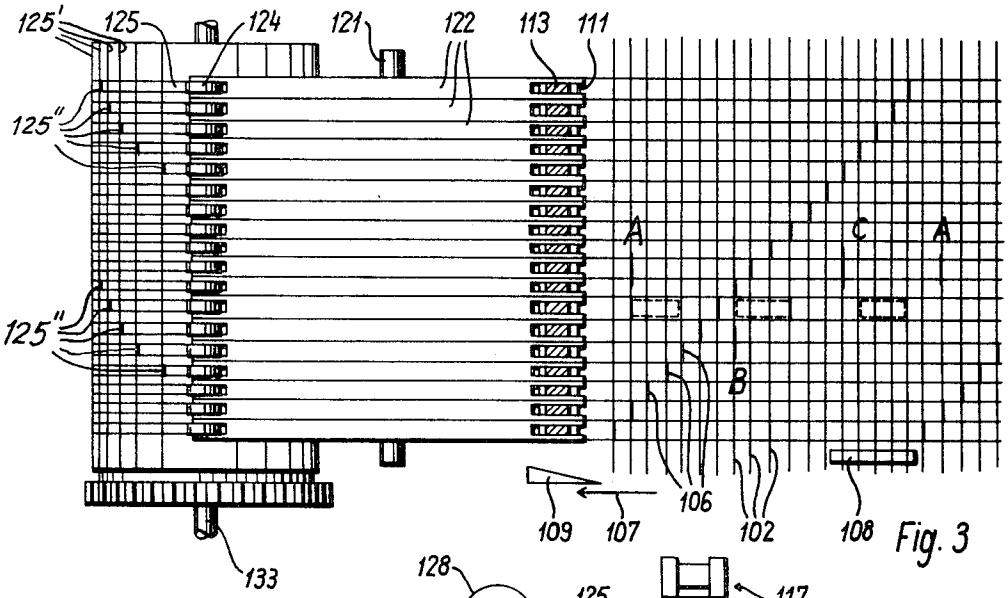


Fig. 3

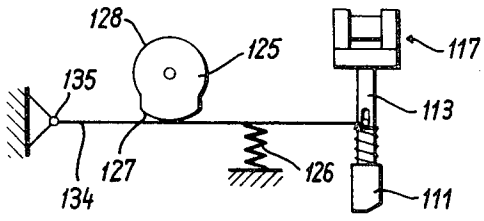


Fig. 4

INVENTOR

KARL FLAD

BY Craig, Antonelli, Stewart & Hill

ATTORNEYS

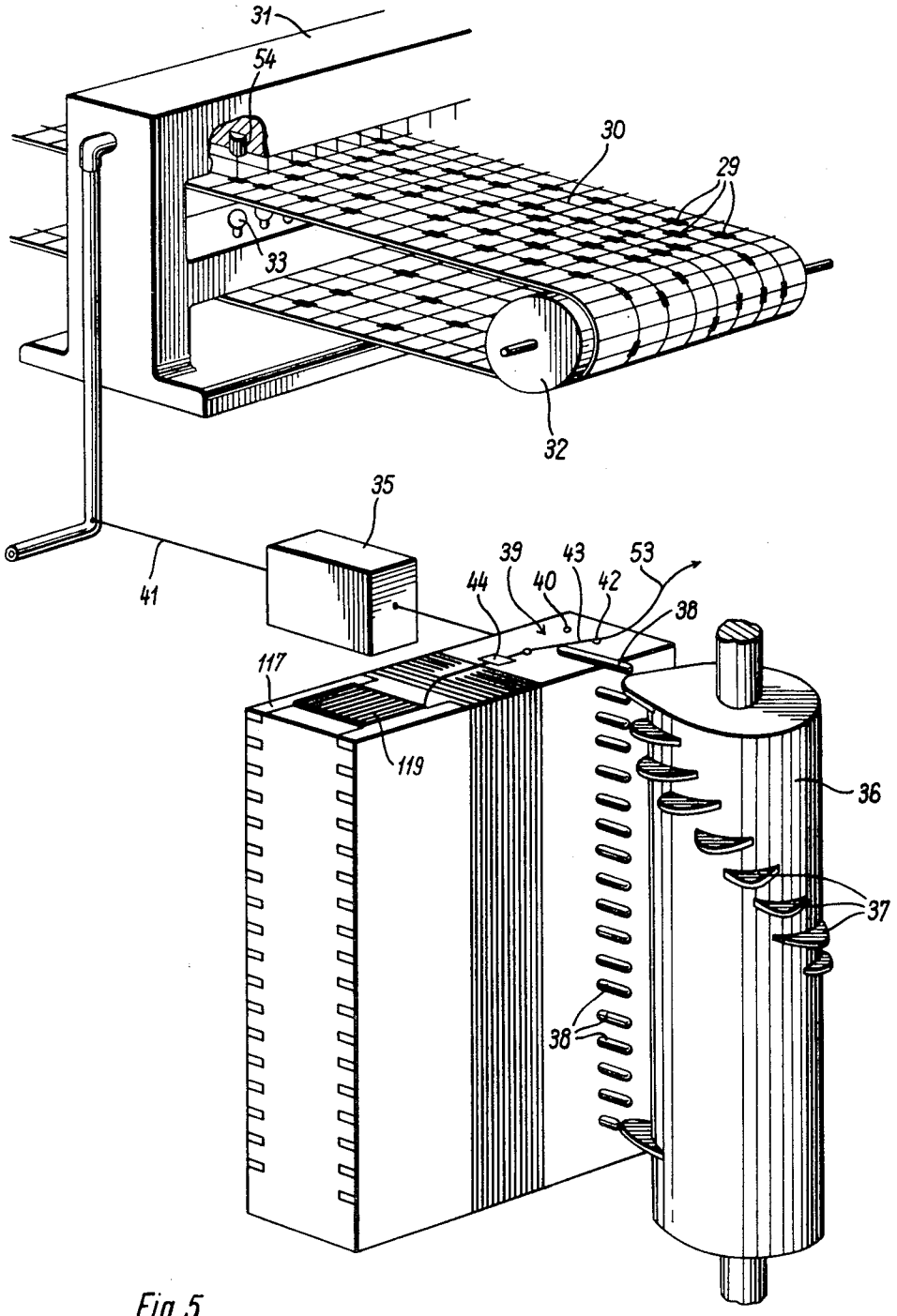


Fig. 5

INVENTOR

KARL FLAD

BY Craig, Antonelli, Stewart & Hill

ATTORNEYS

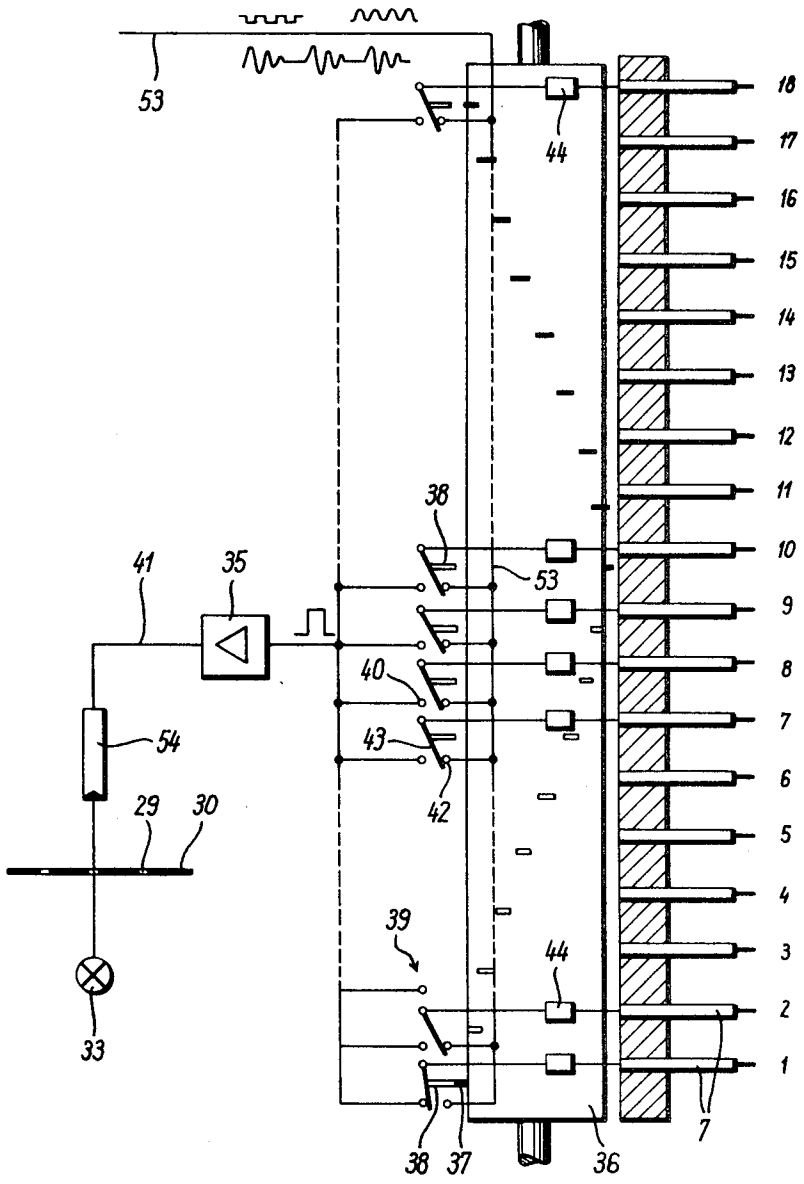


Fig. 6

INVENTOR

KARL FLAD

BY Craig, Antonelli, Stewart + Hill

ATTORNEYS

KNITTING MACHINE WITH DEVICE FOR JACQUARD PATTERNING

The invention relates to a knitting machine with a device for Jacquard patterning which embodies a read out device for information corresponding to a pattern and a selection device controlled thereby for electromagnetic selection of the needles, having parts associated with the needles which are movable by means of guide surfaces into an operative position in which they act on the needles and into an inactive position in which they remain without influence on the needles.

Such a knitting machine is known from U.S. Pat. No. 3,313,128. In this circular knitting machine a read-out device and a pattern wheel are driven synchronously by the rotating needle cylinder, the axis of the pattern wheel being inclined to the axis of the needle cylinder. The periphery of the pattern wheel embodies radial teeth which are adapted to be moved forward and back. Teeth located in the operative position engage the feet of jacks arranged behind the needles in the needle duct of the needle cylinder. Teeth which are not in the operative position do not engage the feet of the jacks concerned. Owing to the inclined position of the pattern wheel relatively to the needle cylinder the teeth located in the operative position guide the jacks upwardly in the needle cylinder during the rolling movement of the pattern wheel on the needle cylinder and thus into a position in which the respective needle is engaged by the cam carriage to perform a working operation.

In this known arrangement, one end of a spring rod is fixed to the inner end of the radially displaceable teeth and the other end is secured to the pattern wheel. The spring rod is extended upwardly beyond the attachment point where it engages in a stationary guide duct. This guide duct is forked in the direction of rotary movement of the pattern wheel directly behind the poles of a stationary magnet arrangement. The intermediate member lying between the two stationary guide duct branches has the form of a wedge which is curved around the axis of the pattern wheel and which leads radially outwardly the ends of the springs in the outer duct and thus guides also outwardly the associated tooth. The magnet arrangement is part of the electromagnetic needle selection device controlled by the read-out device and ensures that the spring rods of the teeth which are not selected enter the one branch duct which runs concentrically around the axis of the pattern wheel, but the spring rods of the selected pattern teeth enter the other, eccentrically disposed branch of the guide duct.

The rod springs are guided over an inclined surface stationary relative to the rotating pattern wheel to the pole of a magnet and retained by the magnet against the spring force of the rod springs. The magnet exhibits a very narrow magnetic pole occupying only approximately the width of a single spring rod; this magnet is connected to the read-out device. If this magnet is magnetized, the spring ends remain attracted and the spring rods enter the concentric guide branch. If, however, the magnet produces no magnet field, the spring rod moves away from the pole face of the latter in the region of the small pole of the magnet under the action of its natural spring force and by the rotary movement of the pattern movement it passes into the eccentrically

disposed branch of the guide duct, whereby the associated tooth is moved outwardly into its operative position.

A disadvantage of this arrangement lies in the fact that the spring rods wear comparatively quickly in operation and in general must be replaced approximately annually, whereby the whole machine is out of use for a certain period and moreover the replacement of the springs involves a comparatively high cost. Also the mechanical construction of the whole patterning device is so complicated that the cost of the knitting machine is thereby seriously increased. A particular disadvantage of this known knitting machine in which the needles are selected synchronously with the rotation of the needle cylinder lies in the fact that the rotation speed of the needle cylinder depends on the speed at which the needles can be selected. Since in this knitting machine always only single spring rod must be located in the region of the small magnet pole performing the selection, the selection speed is limited by the period in which a spring rod can swing so far that it enters reliably into the eccentric branch duct on its further movement. Also, in the period in which the pattern wheel moves on by one tooth pitch the electromagnet with the small pole must be oppositely magnetized if the following tooth is to have a different position that the preceding tooth. The reverse magnetization of a magnet does not however, proceed as quickly as required since the magnet has a certain upper limiting frequency determined by its construction, which cannot be exceeded if the magnet pole is to have sufficient magnetization for reliable operation of the pattern wheel. Since the selection magnet must produce a certain force sufficient to retain the end of the spring rod the peripheral speed of the needle cylinder is comparatively low owing to the time required for the selection operation.

The invention is directed to the problem of providing a knitting machine which overcomes the disadvantages of the known knitting machine.

The problem is solved according to the invention by the fact that the selection device embodies several electromagnets which are controlled by the read-out device and each of which is associated with an adjustable guide surface which it adjusts and each of which is intended for controlling a group of parts, and the parts of one group are separated from each other by a number of parts of other groups which number is smaller by 1 than the number of electromagnets., that the adjustable guide surfaces are staggered transversely to the relative movement between the parts and guide surfaces and the parts are provided with control surfaces which are staggered correspondingly and which come into engagement with the respective associated adjusted guide surface. An advantage of the invention lies in the fact that the working speed of the knitting machine can be substantially increased despite having a series read out. When using ten electromagnet systems the working speed can be increased ten fold so far as other factors do not prevent this. By the invention the result is obtained that the working speed of the knitting machine is no longer limited by the electromagnets. Accordingly very strong electromagnets which therefore have a relatively low upper limiting frequency can be used. By the use of very powerful magnets, an extremely reliable

selection is obtained so that there are no knitting faults due to faulty selection, which can easily occur with selection systems operating near the upper limiting speed. Owing to the fact that powerful magnets are used despite the high selection speed, there is the possibility of adjusting a guide surface directly by the magnets. This gives the advantage that the spring rods and like parts liable to rapid wear, as are provided in the known knitting machines, can be omitted and the machine can be constructed so robustly that it can operate for a long period without repairs and without a replacement of parts. It is further possible by the invention to construct the parts associated with the needles as plates which operate the needles. By virtue of the invention the plates of circular knitting machines or the jacks of flatbed knitting machines can be selected directly and can be moved into the rest position or into the operative position. In circular knitting machines, the parts which bring the needles into the operative positions are referred to as plates, whereas in flatbed knitting machines the parts which bring the needles into the operative position are referred to as jacks. It is also possible to save the pattern wheel together with the radially adjustable teeth; the plates located in the needle cylinder of the circular knitting machine, or the jacks located in the needle bed of the flatbed machine can be selected directly; thereby the knitting machine is simplified in construction and its production is substantially reduced in cost. Moreover the space required owing to the laterally projecting pattern wheel is reduced since the device according to the invention can be arranged to save space.

It is possible to effect the movement of the parts into the rest position and also into the working position by adjustable guide surfaces. In a preferred constructional form of the invention, however, a stationary bearing surface is provided which moves the parts contrary to the direction in which they are moved by the adjustable guide surfaces. Preferably, the parts are moved to their working position by the bearing surface and are moved back to their rest position by the adjustable guide surfaces in accordance with the selection demanded by the pattern. In such case the bearing surface is provided directly in front of the adjustable guide surfaces in the direction of movement of the parts.

The selected parts which have not run on to the guide surface and therefore remain in the working position are moved forward in their longitudinal direction by running onto a lifter cam, whereby they come either into a position in which they are engaged by the main cam or whereby they move directly the needles into a position in which they are engaged by the main cam. In one constructional form of the invention in which the parts are arranged as plates, the plates have such profiles at their ends facing the lifter cam and the lifter cam also has such profile that guiding of the ends of the plates is obtained. Thereby there is produced in practice a close-fitting connection between the ends of the plates and the lifter cam so that the ends of the plates are not moved by any disturbances, e.g., vibrations, out of the region of the lifter cam so that they do not travel to the end of the lifter cam which may lead to patterning faults. The operational reliability of the machine is substantially increased by this construction of the ends of the plates and of the lifter cam, with advantageous results.

The adjustable guide surfaces can be provided substantially with any desired mutual arrangement. E.g., the guide surfaces may be provided at a spacing in the direction of relative movement between guide surfaces and plates, the spacing being equal to the spacing between the plates.

In this case all the magnets operatinG the adjustable guide surfaces can be controlled simultaneously. The control of the magnets and the reading out of the information can in this case be effected for all the magnets simultaneously. The read-out device can operate in this case as slowly as the magnets. In general, however, the read-out devices operate much more quickly than the magnets so that a read-out device can feed several magnets without difficulty. In a preferred constructional form of the invention, the adjustable guide surfaces are arranged in one row parallel to the longitudinal axis of the plates. The individual magnets operating the adjustable guide surfaces are controlled one relatively to the other at such timed intervals as correspond to the timed spacing between two plates. An advantage of this arrangement lies in the fact that the mechanical construction of the arrangement is greatly simplified if the adjustable guide surfaces and the magnets operating them are arranged in one row and can thus be produced in the form of a compact unit.

The control surfaceS of the plates may be produced for example in the form of depressions formed in the plates. In a preferred constructional form of the invention, however, the control surfaces of the plates are in the form of feet of the plates and the location of the plate feet at the plates is chosen for each group of plates according to the associated adjustable guide surface. There are, therefore, as many types of plates as there are different adjustable guide surfaces. By reason of the fact that the guide surfaces are in the form of plate feet which project away from the plate bodies proper, it is possible to allow the plates to remain in the groove even in the raised position; only the plate foot projects from the groove.

The magnets may operate the adjustable guide surfaces directly e.g., they may be constructed as pull magnets which attract against the action of a spring their armature and the guide surface connected to the armature and thereby move the adjustable guide surface into the one or the other position corresponding to the intended pattern. In a preferred constructional form however the adjustable guide surfaces are connected to a magnet armature which is adapted to be moved mechanically to the poles of the associated electromagnet. This arrangement has the particular advantage that the electromagnets can be made substantially smaller than in the previously described case, since the electromagnets merely have to retain the armature but do not have to attract the latter. A holder magnet is, however, substantially smaller for the same attraction force than a pull magnet which must attract its armature.

The magnet armature of the electromagnet may be mechanically connected e.g., by a spring, to the mechanical drive. In a preferred constructional form of the invention the magnet armature is so arranged that durIng movement to the poles of the electromagnet, it follows the mechanical drive but that, during its movement in the opposite direction, it is driven by the mechanical drive. This construction has the advantage

that the magnet armature is always moved to the poles of the electromagnet independently of any varying frictional factors or other disturbing influences. Thereafter the mechanical drive can move away again since in this direction of movement it is merely functionally connected with the magnet armature. For this purpose the functional connection may be produced by a spring the spring force of which is so proportioned that it does not exceed the force holding the magnet armature at the poles of the electromagnet when the electromagnet is energized. On the other hand, this has the advantage that the force of the spring overcomes possible adhesion of the armature as a result of residual magnetism when the magnet is not energized and the magnet armature should drop away, and causes reliable release of the magnet armature.

The adjustable guide surfaces may be fitted directly to the magnet armature. In a preferred constructional form of the invention, however, the adjustable guide surfaces are arranged at one end of a rod the other end of which is fitted to the magnet armature. This has the advantage that the designer can select relatively freely the arrangement and mutual positioning of guide surfaces, magnet armatures and magnets, and can adapt such arrangement and positioning to the particular type of construction of the machine to which the device is to be fitted.

The mechanical drive can be arranged in various ways. E.g., the mechanical drive may be effected by cylinder-piston devices which are operated hydraulically or pneumatically. The drive may also be effected by a crank drive. In a preferred embodiment of the invention, however, the mechanical drive of the magnet armature and of the adjustable guide surface connected thereto is derived from a cam disc. It is possible in a simple way by means of a cam disc to obtain any desired timed motion of the mechanical drive. Moreover a cam disc allows alteration and exchange without difficulties if it should be necessary under particular circumstances to vary the movement and speed of the mechanical drive.

According to the diameter of the cam disc provided, an operating action can be provided for on a part of the periphery so that several working operations can be carried through during one revolution of the cam disc. In preferred embodiments of the invention, however, the cam disc executes one revolution in a given period during which the plates have moved relatively to the guide surfaces by an amount which is equal to the spacing between two plates of one group. In this way cam discs of relatively small diameter can be used and thereby relatively small accelerations and retardations of the mechanical drive can be ensured which has the advantage that the machine runs very quietly and the wear of the working parts is relatively small.

The transmission of movement from the cam disc to the magnet armature may be effected e.g., by means of push rods. In a preferred constructional form of the invention, the transmission of movement from the cam disc to the rod carrying the magnet armature is effective by means of a rocket one end of which follows the shape of the cam disc and the other end of which is connected to the rod which is arranged approximately perpendicularly to the rocker and the rocker pivot axis. By the use of a lever arranged as a rocker, a desired ratio can be imparted to the movement provided for by the cam disc to increase it or reduce it according to requirements. By the use of a lever, it is moreover possible to arrange the magnet and the cam disc laterally of one another.

The connection of the rod to the end of the rocker may be effected in various ways. In a preferred constructional form of the invention the rod embodies a cross pin which runs approximately parallel to the rocker axis and engages a slot which is provided in the region of the end of the rocker end near the rod may be forked, as is provided in a further constructional form, and each of the two arms of the fork may be provided with a slot.

In constructional forms of the invention a release spring is provided which rests on the one hand against the rod and on the other hand against the rocker and exerts a force which tends to separate the magnet armature from the magnet poles, wherein the force exerted by the release spring is less than the force required for separating the magnet armature when the electromagnet is energized. This embodiment of the invention has the advantage that on the one hand the parts of the mechanical drive rest one against the other without play owing to the action of the release spring and on the other hand, as already stated, the release spring facilitates the disengagement of the magnet armature from the poles of the electromagnet. When the electromagnet is not energized and the magnet armature should fall away from the poles, possible sticking of the armature to the poles, which may be caused by remanence, is overcome by the force exerted by the release spring and thus a reliable and disturbance free operation of the device according to the invention is obtained. At the same time the release spring exerts a force on the rocker which ensures that the end of the rocker facing the cam disc rests on the latter.

Alternatively the release spring may, however, be so constructed that it exerts no force or only a small force on the rocker when the magnet armature has been released. In these cases according to a further embodiment of the invention the one end of the rocker bears against the cam disc under the action of a rocker spring. The rocker spring holds the end of the rocker in engagement with the cam disc independently of the release spring and independently of whether the magnet armature has been attracted or released. In place of the rocker spring alternatively a positive guiding of the rocker end on the cam disc may be provided, e.g., in such manner that the end of the rocker engages a groove of the cam disc whereby the end of the rocker is forced to follow the course of the groove in the cam disc.

In a preferred construction form of the invention the slot is arranged at the rod-facing end of the rocker in such relation to the cross pin of the rod that during the movement of the magnet armature derived fRom the cam disc towards the poles of the electromagnet the cross pin bears against the end of the slot remote from the magnet armature and thereby transmits the movement in a functional way. If, however, after the magnet armature has been guided to the poles of the magnet the rocker moves in the opposite direction again, the magnet armature is not thereby pulled away from the poles since the cross pins can move in the slot in this

direction. The positive connection between the magnet armature and the rocker is provided in this position of the mechanical drive by the release spring.

In embodiments of the invention, a constructional simplification of the invention is obtained by the fact that the cam disc for the armatures of all the electromagnets are fixedly mounted on a common shaft and are offset one against another by an angle in each case which corresponds to the spacing of two plates from one another. Thereby there is attained not only a very compact unit, but also a common drive can be provided for all the cam discs. In a further construction of this embodiment the rockers may embody a common pivot axiS which runs parallel to the axis of the cam discs. There is obtained in this way a very compact constructional unit which comprises all the mechanical components as well as the associated electromagnets. The constructional unit may be so arranged that it can be exchanged by means of a few manual operations if trouble arises so that stoppages of the machine caused by such disturbances can be kept short.

The cam disc may be so constructed that it feeds the magnet armature to the poles of the electromagnet and immediately afterwards the functional connection is dissolved. In a preferred constructional form of the invention, however, the cam disc holds the rocker during about ¾ revolution in a position in which the magnet armature is guided to the poles of the electromagnet by a functional connectiOn, and during about ¼ revolution the rocker is held in a position in which the magnet armature is releasable from the poles, assisted by the force of the release spring. This embodiment has the advantage that the instants of magnetization and demagnetization do not need to be synchronized extremely exactly with the particular position of the cam disc but may depart somewhat therefrom whereby difficulties in the timing of the various operations can be avoided.

The adjustable guide surface may be arranged e.g., as abutment surface at the lower end of the rod and may force the plate located beneath it into the groove when the magnet armature is released. This would, however, require that the release of the magnet armature must be effected in the time interval in which the passing plate is located under the abutment surface of the rod. In order to reduce this requirement as regards the timing, a preferred embodiment of the invention provides that the adjustable guide surface is disposed on a slider and is provided with a sloped surface inclined to the direction of travel of the plate feet. In this case the slider is preferably guided in a guide way directed in line with its longitudinal axis. By the arrangement of the guide surface as an inclined surface it is possible to release the guide surface at any desired moment before the approach of the plate concerned which by engagement of the foot of the plate with the inclined surface is pressed in the groove and is guided out of the region of the lifter cam. The slider which is subjected to a certain wear since the feet of the plates slide over it may be interchangeably mounted on the rod. The tangential force exerted by the feet of the plates on the guide surface is absorbed by the guide way of the slider and kept away from the rod, the cross pin and the magnet armature.

A constructional embodiment of the invention which is suitable particularly for circular knitting machines, but also for flat bed machines when suitably modified, is provided with a slider which is movable mechanically to its end positions and for each slider a stop is provided which is controlled by always one of the electro magnets and which is displaceable in the path of movement of the controlled slider. In this case the slider is moved mechanically to its end positions and selection by the electromagnets is effected by a stop controlled by the associated electromagnet. An advantage of this embodiment lies in the fact that the reciprocation of the slider is effected practically independently of the magnet and thus no account has to be taken of the force which can be produced by the magnets. Only when the slider is in its end position is the stop controlled by the associated electromagnet displaced into the path of movement of the controlled slider or, according to the information, not displaced. When the stop is displaced the controlled slider can no longer change its position while when the stop is not displaced the controlled slider returns under the action of the spring to its starting position from which it was displaced in a functional way.

In a particularly preferred embodiment a mechanical detention of the slider is provided in both end positions and for this purpose a constructional component part is used which operates the slider by abutting it. The component part for moving the slider by abutment into its one end position is necessary in any case in this embodiment and is thus used multifold since it serves additionally for detaining or locking the slider in its two end positions. For this purpose, this component part embodies e.g., at least one lug which co-operates with at least one depression or a lug on the controlled slider and provides the mechanical detention or locking in both end positions of the slider. It is advantageous in this case that the slider is retained reliably in its selected position even under the influence of vibrations or other disturbanceS so that a false needle selection due to undesired displacement of the slider is practically excluded.

In one construction of the invention the stop is adapted to be displaced into the path of movement of the slider by the force of a spring and to be removed therefrom positively. The stop is, therefore, disengaged by a component part moved synchronously with the operating cycle of the machine and can, according to the selection by the magnets, swing back under the spring force into the path of movement of the slider.

The control of the stop is effected in a preferred embodiment of the invention in such manner that the stop is arranged at the end of one arm of a two-armed lever, the other arm of which carries a magnet armature. On positive disengagement of the stop from the path of movement from the slider, the magnet armature is moved thereby to the magnet. On release of the positive actuation, the magnet armature is retained when the magnet is energized and the stop is retained against the action of the spring which tends to return it. When the magnet is not energized the magnet armature is released under the action of the spring force acting on the stop, and the stop moves back into the path of movement of the slider.

The magnet armature may be fitted rigidly to the lever arm. In preferred constructions, however, the magnet armature is supported pivotally on the lever and is resiliently displaceable thereon tangentially to the direction of movement of the lever. Thereby possible small tolerances in the lever bearing and in the arrangement of the parts can be compensated and the magnet armature can always come smoothly and fully into engagement with the poles of the electromagnet. In a particularly preferred embodiment of the invention the path of the end of the lever carrying the armature is longer in this case than the path of the armature. Thereby the armature is brought not only to the pole of the electromagnet, but is pressed against the pole of the electromagnet under the influence of its resiliently yieldable bearing on the lever arm. This "over pressure" leads not only to a bearing of the magnet armature virtually without air gap on the poles of the electromagnet, but it also results in a very smooth running of the machine.

In embodiments of the invention the magnet cassette embodies guide lugs having guide surfaces which are inclined to the direction of movement of the magnet armature and the mutual spacing of which is reduced in the direction towards the pole faces of the electromagnets. These guide lugs ensure that the magnet armature is guided exactly onto the pole faces of the electromagnets despite the presence of bearing play against the lever and despite the presence of bearing play of the lever itself, since the guide surfaces of the guide lugs guide the magnet armature into the correct position.

In embodiments of the invention the energization and de-energization of the electromagnets is synchronized with the mechanism leading the armatures against the magnet poles, in such manner that the energization occurs only when the armature is pressed on, the de-energization however is effected after the armature has been released. Owing to the fact that the energization occurs only when the armature rests on the pole face adjacent parts are prevented from being influenced by stray effects which would occur to high degree as long as the path of the magnetic flux through iron is not yet completely closed.

Owing to the long time tolerances which are permissible owing to the invention there is no need for making high demands on the synchronization so that the latter can be effected without great expenditure and can be constructed very simply.

The magnet armature, for example, may consist of a hard magnetic material. With an appropriate magnetization of the poles of the electromagnets the magnet armature is then attracted, with the opposite magnetization of the poles the magnet armature is repelled. However, it is also possible to produce the magnet armature from a soft magnetic material. The armature is then detained as long as the magnet is energized independently of the direction of the magnetization of the poles of the magnet. When the energization is removed the magnet armature is released. However, it may happen in this case that the magnet armature "sticks" when the releasing force is small with which it is pulled off the poles. This may be counteracted by a suitable selection of the material of the magnet armature which must have as low a remanence as possible. In an embodiment of the invention, however, provision is made that the electromagnets are arranged to be connected for the selection process to a de-magnetizing current source. This de-magnetizing current source delivers, for example, a short direct current impulse the polarity of which is opposite to the energization. The direct current impulse may be dimensioned in this case in such manner that it cancels the remanent magnetism. Thereby, sticking of the magnet is avoided and the armature is released with certainty. As a de-magnetizing current source, alternatively a circuit arrangement is suitable which delivers an impulse in the form of a current of a de-magnetization oscillation. Such circuit has the advantage that always good de-magnetisation occurs because the amplitude of the alternating field produced tends to zero in a pulsating manner.

It has already been stated that with an appropriate arrangement of the electromagnets parallel selection of the information and parallel operation of the magnets is possible. In this case a single magnet group may be provided which controls successively the individual plate groups. However, it is also possible to provide as many magnet groups as plate groups are present, whereby it is possible to adjust all plates simultaneously. Such embodiments in which as many information channels are required as magnets are provided are particularly suitable for flat bed knitting machines. In preferred embodiments of the invention which are particularly suitable for circular knitting machines the read-out device reads the information signals for the individual electromagnets in succession and a distributor is provided which distributes the information signals to the individual electromagnets, the read-out device, the distributor and the mechanism leading the magnet armatures to the magnet poles being synchronized relatively to each other. Such embodiment has the advantage that only one information channel with a single scanning path is necessary.

The signal for each magnet is obviously only of such maximum length as corresponds to the time spacing between two plates. In an embodiment of the invention, therefore, a circuit is provided between the read-out device and the electromagnet which lengthens the signal of the read-out device. Thereby it is possible to utilize the powerful and robust electromagnets in spite of the read-out in series connection. Such pulses lengthening circuits are known. For this purpose, for example, relays with delayed opening action or the circuit known as monostable multi-vibrator may be used.

The apparatus may be so constructed that the electromagnet is energized as long as a signal is present. In other embodiments of the invention, however, the electromagnet is energized as long as no signal of the read-out device is present. The signal of the read-out device has the effect that the electromagnet is de-energized, for example by disconnecting the energization or by switching on a de-magnetization, whereby the magnet armature is released and the adjustable guide path is controlled accordingly. In embodiments of the invention the output signal of the read-out device controls change-over switches by which the electromagnets are connected alternately to an energizing or a de-energizing current source. It would also be possible to feed the magnets with the impulses delivered by the read-out device, under certain circumstances after re-shaping and/or amplification.

The magnet armature may be fitted rigidly to the lever arm. In preferred constructions, however, the magnet armature is supported pivotally on the lever and is resiliently displaceable thereon tangentially to the direction of movement of the lever. Thereby possible small tolerances in the lever bearing and in the arrangement of the parts can be compensated and the magnet armature can always come smoothly and fully into engagement with the poles of the electromagnet. In a particularly preferred embodiment of the invention the path of the end of the lever carrying the armature is longer in this case than the path of the armature. Thereby the armature is brought not only to the pole of the electromagnet, but is pressed against the pole of the electromagnet under the influence of its resiliently yieldable bearing on the lever arm. This "over pressure" leads not only to a bearing of the magnet armature virtually without air gap on the poles of the electromagnet, but it also results in a very smooth running of the machine.

In embodiments of the invention the magnet cassette embodies guide lugs having guide surfaces which are inclined to the direction of movement of the magnet armature and the mutual spacing of which is reduced in the direction towards the pole faces of the electromagnets. These guide lugs ensure that the magnet armature is guided exactly onto the pole faces of the electromagnets despite the presence of bearing play against the lever and despite the presence of bearing play of the lever itself, since the guide surfaces of the guide lugs guide the magnet armature into the correct position.

In embodiments of the invention the energization and de-energization of the electromagnets is synchronized with the mechanism leading the armatures against the magnet poles, in such manner that the energization occurs only when the armature is pressed on, the de-energization however is effected after the armature has been released. Owing to the fact that the energization occurs only when the armature rests on the pole face adjacent parts are prevented from being influenced by stray effects which would occur to high degree as long as the path of the magnetic flux through iron is not yet completely closed.

Owing to the long time tolerances which are permissible owing to the invention there is no need for making high demands on the synchronization so that the latter can be effected without great expenditure and can be constructed very simply.

The magnet armature, for example, may consist of a hard magnetic material. With an appropriate magnetization of the poles of the electromagnets the magnet armature is then attracted, with the opposite magnetization of the poles the magnet armature is repelled. However, it is also possible to produce the magnet armature from a soft magnetic material. The armature is then detained as long as the magnet is energized independently of the direction of the magnetization of the poles of the magnet. When the energization is removed the magnet armature is released. However, it may happen in this case that the magnet armature "sticks" when the releasing force is small with which it is pulled off the poles. This may be counteracted by a suitable selection of the material of the magnet armature which must have as low a remanence as possible. In an embodiment of the invention, however, provision is made that the electromagnets are arranged to be connected for the selection process to a de-magnetizing current source. This de-magnetizing current source delivers, for example, a short direct current impulse the polarity of which is opposite to the energization. The direct current impulse may be dimensioned in this case in such manner that it cancels the remanent magnetism. Thereby, sticking of the magnet is avoided and the armature is released with certainty. As a de-magnetizing current source, alternatively a circuit arrangement is suitable which delivers an impulse in the form of a current of a de-magnetization oscillation. Such circuit has the advantage that always good de-magnetisation occurs because the amplitude of the alternating field produced tends to zero in a pulsating manner.

It has already been stated that with an appropriate arrangement of the electromagnets parallel selection of the information and parallel operation of the magnets is possible. In this case a single magnet group may be provided which controls successively the individual plate groups. However, it is also possible to provide as many magnet groups as plate groups are present, whereby it is possible to adjust all plates simultaneously. Such embodiments in which as many information channels are required as magnets are provided are particularly suitable for flat bed knitting machines. In preferred embodiments of the invention which are particularly suitable for circular knitting machines the read-out device reads the information signals for the individual electromagnets in succession and a distributor is provided which distributes the information signals to the individual electromagnets, the read-out device, the distributor and the mechanism leading the magnet armatures to the magnet poles being synchronized relatively to each other. Such embodiment has the advantage that only one information channel with a single scanning path is necessary.

The signal for each magnet is obviously only of such maximum length as corresponds to the time spacing between two plates. In an embodiment of the invention, therefore, a circuit is provided between the read-out device and the electromagnet which lengthens the signal of the read-out device. Thereby it is possible to utilize the powerful and robust electromagnets in spite of the read-out in series connection. Such pulses lengthening circuits are known. For this purpose, for example, relays with delayed opening action or the circuit known as monostable multi-vibrator may be used.

The apparatus may be so constructed that the electromagnet is energized as long as a signal is present. In other embodiments of the invention, however, the electromagnet is energized as long as no signal of the read-out device is present. The signal of the read-out device has the effect that the electromagnet is de-energized, for example by disconnecting the energization or by switching on a de-magnetization, whereby the magnet armature is released and the adjustable guide path is controlled accordingly. In embodiments of the invention the output signal of the read-out device controls change-over switches by which the electromagnets are connected alternately to an energizing or a de-energizing current source. It would also be possible to feed the magnets with the impulses delivered by the read-out device, under certain circumstances after re-shaping and/or amplification.

The association in time of the output signal of the read-out device with the position of the plate to be controlled which corresponds to this instant of time, may be freely selected within wide limits. In embodiments of the invention the output signal of the read-out device with the start of which the electromagnet receives the de-magnetizing current, is arranged at an instant of time at which the associated plate is still located in front of the adjustable guide surface. In this case, the de-magnetizing current is still flowing after the magnet pole has been guided by the mechanism to the magnet poles. If the instant of time were so selected that the associated plate is located already under the guidance, the possible period of time during which the impulse may arrive without the selection being impaired would be greatly reduced. Also, the instant of time at which the de-magnetizing current is switched off may fluctuate within limits; it must merely be so selected that at the instant at which the mechanism moves back again from the magnet poles the magnet is fully energized again under certain circumstances and is capable again of detaining the magnet armature.

The electromagnets may have any conventional known configuration. In an embodiment of the invention the core of the electromagnet is in the shape of a U the ends of the limbs of which form the magnet poles and the yoke of which supports the winding. Also the limbs may be so extended that the shape of an H is produced. In other embodiments of the invention the magnet core is in the form of an E, the coil being would around the central limb thereof and the ends of the three limbs forming magnet poles. This embodiment has the advantage that the coil can be finished wound on a mandrel and thereafter pushed upon the magnet core and fixed thereon. The coil need not be wound around the core and is therefore interchangeable, when required.

Generally, the selected plates or jacks actuate the needles in order to move them into the operative position or to leave them in the rest position. In embodiments of the invention the plates or jacks may be so constructed that they select the needles directly. In this manner, the expense for the machine is reduced. In this case the plates of embodiments of the invention adhere by friction to the grooves in which they are disposed. The plates consist, for example, of generally flat sheet metal strips which, however, are not uniformly flat but are slightly cranked once or more times, that is to say they are slightly corrugated along their length and rest against the sides of the grooves with a resilient bias. The width of the groove is slightly greater than the thickness of the plates. The friction connection is sufficient for retaining the plates in position in the beds of flat bed knitting machines which may be disposed horizontally or inclined. The friction connection, however, is also sufficient for holding the plates of circular knitting machines in the grooves against the force of gravity and against the centrifugal force exerted thereon during the rotation of the cylinder. The use of a friction connection for detaining the plates does not require additional expenditure which would otherwise be necessary if the plates had to be held in close contact.

As mentioned already, the invention can be used for a flat bed knitting machines and purl-purl knitting machines as well as for circular knitting machines.

Several embodiments of the invention are described below by way of example with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic perspective view of a part of a knitting machine constructed in accordance with the invention showing the knitting machine rotated approximately 90° from its in use position,

FIG. 1A is an enlarged schematic view showing details of a mounting of cams for effecting movement of plates,

FIG. 2 is a diagrammatic view of the mechanism leading the magnet armature to the magnet,

FIG. 3 is a simplified illustration of a section along the line III — III of FIG. 2 with plates shown diagrammatically in one plane,

FIG. 4 is a diagrammatic illustration of another mechanism for leading the magnet armature to the electromagnet,

FIGS. 5 and 6 illustrate control elements for the selection device and a circuit diagram for the control of the electromagnets in accordance with information stored on a tape.

In a circular knitting machine a section of which is illustrated in FIG. 1, plates **102** are disposed in grooves **103** in a needle cylinder **101**. The plates **102** are provided with semi-circular recesses **105** at their ends remote from needles **104**. The plates have a flat configuration and each is provided with an upwardly projecting plate foot **106** or control face. The needle cylinder **101** rotates in the direction of the arrow **107**. During the rotation the plates **102** are pushed out of the grooves **103** by a stationary adjusting cam **108** having a stationary adjusting face to such extent that at least the plate feet **106** project from the outer face of the needle cylinder **101**. The ends provided with the recesses or profiles **105** of the upwardly displaced plates run upon a lifter cam **109** which is provided on the side adjacent to the plate ends with an enlargement **110** of semi-circular cross-section which fits into the recesses or profiles **105** and serves as a guide for the plate ends which prevents displacement of the plate ends in a radial direction. The lifter cam **109** is also stationarily disposed, similarly to the adjusting cam **108**. Whereas, however, the adjusting cam **108** moves the plates outwardly in a radial direction, the lifter cam **109** moves the plates **102** in an axial direction.

FIG. 1A illustrates in detail how the cams **108** and **109** are mounted without colliding with the drive of the needle cylinders. The needle cylinder **101** is rotatably disposed on a fixed chamber *a*. The cams **108** and **109** are attached to this fixed hollow cylinder *a*. Cylinder *a* exhibits an annular extension *b* on the outside which is fixed to the engine housing. The needle cylinder **101** extends past the height of the hollow cylinder *a*. At the lower end of the needle cylinder **101**, a toothed rim gear *c* is disposed which has outside teeth *d* for meshing with a gear of a motor that can be attached to extension *b*. The bottom portion of the jacks **105** project below the needle cylinder slots and adjacent a reduced needle cylinder continuation. The extension *b* also carries the guide bar **136** with the slides **111**.

In order to attain plate selection certain plates must be so moved in a radial direction that they miss the lifter cam **109**, after previously all plates had been moved by the adjusting cam **108** into the position in which they are engaged by the lifter cam **109**. The

selection of the plates which miss the lifter cam **109** is effected by sliders **111** which are guided in a radial direction in a guide rail **136** and which have inclined faces **112**. The sliders **111**, a plurality of which are disposed in an axially extending row and each of which is individually actuable, can be displaced into two positions: into a lower one in which the plate feet **106** run upon the inclined face **112**, and into an upper one in which the travelling plate feet **106** do not touch the sliders **111**. The inclined face **112** is so inclined that it forms a gap which narrows wedge-like in the direction of movement of the surface of the needle cylinder **101**. When a plate foot **106** runs upon the inclined face **112** the plate foot is pressed radially inwardly and the plate **102** is pressed into the groove **103**. The clear width of the grooves is slightly greater than the plate thickness and the plates stick in their grooves owing to the fact that they are slightly bent or corrugated laterally and thereby rest against the sides of the grooves with friction contact. By means of the slider **111** therefore a selection of the plates **102** is possible owing to the fact that certain plates reach the lifter cam **109** and are moved axially by the lifter cam **109**, whereas other plates selected by lowering the slider **111** are pivoted out of the region of the lifter cam **109** and thereby retain their original axial position.

The sliders **111** are attached to the lower end adjacent to the needle cylinder **101** of rods **113** which are directed approximately radially to the needle cylinder **101**. To the end of the rod **113** remote from the needle cylinder **101** a magnet armature **114** is pivotally attached which in the upper position of the slider **111** rests against poles **115**, **116** of an electromagnet **117**. The electromagnet **117** has an H-shaped core **118** the yoke of which is surrounded by a winding **119**. The rod **113** is provided in its center region with a cross pin **120** which is disposed approximately parallel to the axis of the needle cylinder **101**.

A rocker **122** is pivotally movable about a shaft **121** the axis of which extends parallel to the axis of the needle cylinder **101**. The rocker **122** is approximately perpendicular to the rod **113** and is disposed approximately tangential to the surface of the needle cylinder **101**. The rocker **122** is provided at each of its two ends with a slot which extends approximately radial to the needle cylinder **101** and by which the ends of the rocker **122** receive a fork-like configuration. The fork-like end of the rocker **122** adjacent to the rod **113** embraces the rod **113** in the region of the cross pin **120** which engages into elongated openings **123** which extending in the direction of the rod **113** are provided in the parts of the rocker **122** surrounding the slot. Thereby the rod **113** is movable in its longitudinal direction, when the rocker **122** is stationary, to an extent permitted by the length of the openings or slots **123**. At the end of the rocker remote from the rod **113** a roller **124** is rotatably mounted in the slot and rests against the periphery of a cam disc **125** under the effect of a compression spring **126** which is supported by a stationary machine part, for example the machine casing. The cam disc **125** is provided with four peripheral sections: a section **127** which occupies approximately one-quarter of the periphery and which has a large radius, a section **128** which occupies approximately three-quarters of the periphery and has a smaller radius, and two transition sections **129** and **130** which are disposed between the two first mentioned sections.

Between the slider **111** which has a larger cross-section than the rod **113**, and the forked end of the rocker **122** adjacent to the rod **113**, a release spring **131** is wound around the rod **113** and is supported at its one end on the slider **111** and at its other end by way of a plate **132** on the forked end of the rocker **122**.

The arrangement comprising the cam disc **125**, the rocker **122**, the rod **113** and the electromagnet **117** is provided several times, for example eighteen times. All rocker members **122** are pivotally mounted about the common shaft **121**. All cam discs **125** are fixedly mounted on a shaft **133** which is driven together with the needle cylinder in such manner that the shaft **133** performs one rotation when the needle cylinder moves forward by one pitch division which corresponds to 18 grooves **103**. The total number of grooves **103**, plates **102** and needles **104** provided in the needle cylinder **101** is a whole number multiple of the number of electromagnets **117**, in the present case a whole number of multiple of eighteen. The cam discs **125** are progressively offset relatively to each other on the shaft **133** always by a uniform angle; the angle is obtained by dividing the circumference into the number of cam discs **125**. Lines **125'** in FIG. **3** represents the circumference dividing lines and lines **125''** represent corresponding similar parts of respective cam discs **125**. Each cam disc **125** thus assumes the same position relatively to its associated plate **102**, because the displacement in time and space of the cam discs relatively to each other is equal to the space and time offset of the plates relatively to each other. The plate feet **106** are disposed differently in the longitudinal direction of the plates **102**. Each slider **111** operates a group of plates the feet **106** of which have the same spacing from the plate end. The individual plates of a group are separated from each other by as many plates of other groups as correspond to the number of cam discs reduced by one. Thus, in the present example which has eighteen cam discs 17 other plates which are associated with other cam discs are always located between the plates of a group. Thus, the plate foot **106** of each eighteenth plate has the same position relatively to the plate end. The plate feet are disposed staggered in such manner that they form the shape of a saw tooth curve as is clear from FIG. **3**, which is diagrammatically illustrated in development.

The selection of the plates is effected by cooperation of the rocker **122** actuated by the cam disc **125** with the energization or de-energization of the electromagnet **117**. When the roller **124** of the rocker **122** is located on the section **128** with smaller radius of the cam disc, the rocker is rotated in an anti-clockwise directed by the compression spring **126**, the cross pin **120** rests at the lower end of the slots **123**, and the rod **113** is moved upwardly until the magnet armature **114** comes to rest at the poles **115** and **116** of the electromagnet **117**. Thereby, the slider **111** is moved simultaneously out of the travel path of the plate feet **106** of the plate group associated therewith. This movement of the rod **113** by which the magnet armature **114** is moved upon the electromagnet **117** is derived by close contact engagement with the cam disc **125**. As soon as the roller **124** travels on to the section **127** with larger radius upon continued rotation of the cam disc **125**, the

rocker 122 is rotated thereby in a clockwise direction against the force of the spring 126. However, the slots 123 are provided with such lengths that the cross pin 120 does not yet attain the other end of the slots 123. When the electro-magnet 117 is energized it detains the magnet armature 114 and the inclined face 112 remains outside the path of the plate feet 106 of the plate group associated therewith. When in contrast the electromagnet 117 is de-magnetized while the roller 124 is located on the section 127 with larger radius (FIG. 1), the magnet armature 114 is pulled off the magnet poles 115 and 116 by the release spring 131 and the rod 113 moves in the direction towards the axis of the needle cylinder 101 until the cross pin 120 comes to rest at the lower end of the slots 123. In this lower position of the slider 111, the inclined face 112 is located in the path of the plate feed 106 of the plate group associated therewith and the next following plate of the group is pressed into the groove 103 of the needle cylinder 101 when its plate foot 106 runs upon the inclined face 112, so that this plate 102 misses the lifter cam 109 and is not moved forward axially. The cam disc 125 makes always one rotation during the period of time in which the plates of a group move forward by the spacing of the plates of this group from each other, so that each plate is individually selectable. The connection between the rod 113 and the cam disc 125 in the movement direction of the rod 113 towards the needle cylinder axis is effected in a positive force transmitting manner by the release spring 131.

The instant of time at which the electromagnets 117 are controlled are indicated in the diagrammatic illustration of FIG. 3. At an instant A at which the approaching plate of the plate group associated with this electromagnet is located at least one plate spacing ahead of the leading edge of the inclined face 112 the rocker is pivoted in the clockwise direction by the roll 124 running upon the transition section 129 of the cam disc 125, and thus the inclined face 112 of the slider 111 is moved into the path of the plate foot 106 of the associated approaching plate 102, if the electromagnet 117 has not been energized. At an instant B when the associated plate 102 has left again the region of the inclined face 112 the roller 124 is located on the transition section 130. During the passage over this transition section the slider 111 is lifted together with the magnet armature 114 and the rod 113 and thereby the inclined face 112 is moved out of the path of the plate feet 106 of the plate group associated therewith. At an instant C which is located approximately in the center region of the section 128 having the smaller radius, that is to say it occurs in time after the instant B and before the instant A, the signal of the read-out device arrives if the next following plate is to engage the lifter cam 109, that is to say if it is not to be pushed back into its groove 103. The energizing current supplied to the winding 119 of the electromagnet 117 lasts from the instant C beyond the instant A and beyond the instant B and terminates in the region between B and C. If, in contrast, the approaching next plate must not engage the lifter cam, a de-magnetizing current is supplied to the winding 119 of the electromagnet 117 at the instant C or shortly thereafter when no signal has arrived from the read-out device, the de-magnetizing current lasting at least to the instant A, in general however terminating only after the instant B. The de-magnetizing current continues to flow under certain circumstances through a plurality of rotations of the cam disc 125 until at an instant C a signal arrives from the read-out device. If, in contrast, a signal arrives from the read-out device, which means that the associated plate is to be engaged by the lifter cam, an energizing current which lasts from the instant C beyond the instant A to the instant B is delivered to the winding at the instant C. The interval C to B corresponds approximately to two-thirds of the spacing of the plates of the same group from each other. In FIG. 2 the instants A, B and C are shown in their approximate position relative to the cam disc 125. It is clear from the indicated positions of the instants A, B and C in FIGS. 2 and 3 how much time is available for controlling the electromagnets 117, compared with the short period of time which would be available if a single magnet were used. When only a single magnet is used only such time is available for energizing and de-energizing the magnet which corresponds to the spacing between two mutually adjacent plates.

FIG. 4 illustrates another embodiment of the mechanical drive of the rod 113 in which no use is made of a rocker, but a lever 134 is used which is pivotally mounted at one end thereof at a fixed bearing point 135 and which is affected directly by the cam disc 125. The cam disc 125 is disposed between the fixed bearing point 135 and the other end of the lever 134 which is adjacent to the rod 113.

The described arrangement comprising one group of magnets and one group of cam discs forms a system. The number of magnets associated with a system is arbitrary under the condition that it corresponds to a whole number fraction of the needles present on the whole needle cylinder. The number of electromagnets in each system depends upon the speed with which a plate can be selected dependent upon the desired rotational speed of the needle cylinder. A circular knitting machine comprises a plurality of such systems which include the magnet group, the mechanism with rockers and cam discs, and one adjusting cam 108 and one lifter cam 109. The technical equipment which is saved by the fact that the magnets affect directly the plates 102 disposed below the needles in the grooves and that springs of any kind and a pattern wheel with teeth are unnecessary is extremely considerable in such circular knitting machines having many systems.

The electromagnets 117 which conventionally have a soft iron core 118 may alternatively be provided with a permanent magnet as core. Or the magnet armature 114 may consist of a permanent magnet. Attraction and repulsion of the magnet armature is effected by a field which acts in the same direction as, or in the opposite direction to the field of the permanent magnet and which is produced by a suitably polarized direct current in the winding 119.

FIGS. 5 and 6 illustrate an embodiment of the control elements for the selection device and a circuit diagram. The information signals for the individual electromagnets of a system are stored successively in a row or column in the direction of movement of a perforated tape containing the information. The perforated tape has as many rows or columns as systems of the machine are controlled differently. It is possible to control, for example, with each column two systems of a circular

knitting machine which are offset relatively to each other by 180° on the machine. Similarly it is possible to control always with one column three or more systems which are then offset relatively to each other by corresponding fractions of 360°. Thereby the same pattern is knitted on the knitting machine twice or three times or more often. In general, however, the number of columns is equal to the number of systems when the pattern is not repeated on the circumference.

The information signals relating to the pattern stored on the tape are read out in that a perforation **29** releases a beam of light emitted from a light source **33** to a photo cell **54**. If, in accordance with the information, there is no perforation the tape obscures the light source. The information signals for the, for example, 18 magnets of a system, are therefore read out successively by the read-out device **31**. The information signals for the mutually corresponding electromagnets of the systems are located in one line of the tape and are read out simultaneously. The information of a column is fed through a conductor **41** and an amplifier **35** to the electromagnet group of a system. A conductor **41** and an amplifier **35** are provided for each system. The information signals **29** may be stored on the tape **30** also in some other form than in the form of perforations, and moreover the read-out elements **33** and **54** may be constructed in some other manner, for example as mechanical contacts or as magnet heads reading out of the magnetization of a magnetic tape.

The information signals for the eighteen electromagnets **117** appear successively at the output of the amplifier **35**; they are read out in series. In order to distribute these information signals to the eighteen magnets in such manner that each magnet receives the information associated therewith at its instant C, a distributor is provided which, in the illustrated embodiment of the invention, is provided with a mechanical member driven in synchronism with the tape **30**, namely a cam roll **36** which supports cams **37** which are disposed in a helical line and which are interchangeably attached to the cam roll **36**. These cams co-operate with actuating pins **38** of change-over switches **39** each of which is associated with a magnet **117** in such manner that the winding **119** of the magnet **117** is connected to the normally open contact **40** of the change-over switch **39** when the information intended for the respective electromagnet **117** arrives at the respective normally open contact **40** which is connected to the amplifier output of the amplifier **35**. The normally closed contact **42** of the individual change-over switches **39** is connected to a conductor **53** which leads to a current source which produces a de-magnetizing current. The de-magnetizing current may consist of, for example, pulsating direct current of a current source which has only approximately one-third of the magnitude of the current strength of the operating current supplied to the windings **119**. The de-magnetizing current, however, may alternatively have the form of a damped oscillation. In this case the starting point of the damped oscillation is preferably synchronized with the rotation of the cam wheel **125**. The movable wiper **43** of the change-over switch **39** is connected to the winding **119** of the magnet **117** by way of a mechanical relay or an electronic pulse forming circuit, for example a monostable multi-vibrator **44**. The circuit **44** has the object to convert the short information signal delivered by the amplifier **35** into a current pulse having a length which corresponds to the time interval C to B. By a suitable choice of the shape of the cams **37**, the duration can be varied during which the normally open contact **40** is connected to the circuit **44**. The cam roll **36** may, for example, be disposed on the same shaft **133** which supports also the cam discs **125**.

It will be understood that the invention is not limited to the embodiments illustrated by way of example, but that modifications thereof are possible without the scope of the invention being exceeded. In particular, it is possible to use features individually or in combination.

What is claimed is:

1. In a circular knitting machine a Jacquard patterning device which comprises read-out device for reading out information relating to a pattern, and a selection device, the machine having needles and parts associated with said needles for displacing selected needles, displaceable guide faces being provided for moving said parts into an operative position in which they can affect the needles, or into a rest position in which they remain without effect upon said needles, said device comprising a plurality of electro-magnetic means controlled by said read-out device, each of said electro-magnetic means being operatively associated with one of said displaceable guide faces to retain said guide face in one of said positions, each guide face being arranged to control a group of said parts, the said parts of each group being separated from each other by a number of parts associated with other groups, said number being smaller by one than the number of electro-magnetic means, said displaceable guide faces and said parts being arranged for mutual relative movement and said guide faces being staggered transversely to the direction of said relative movement, said parts being provided with control faces which are staggered in a similar manner and which are arranged to come into engagement with respective associated displaceable guide faces, each one of said adjustable guide faces being connected to a magnet armature which is arranged to be guided mechanically by a mechanical drive to poles of the associated electro-magnetic means, said adjustable guide face being disposed at one end of a rod at the other end of which rod said magnet armature is disposed, said mechanical drive of said magnet armature and of said adjustable guide face connected to the latter being derived from one of a plurality of cam discs the movement transmission from each one of said cam discs to a respective said rod supporting a respective said magnet armature being effected by a respective one of a plurality of rocker members one end of which rocker member follows the shape of said cam disc, and the other end of which rocker member is in connection with said rod, said rod being disposed approximately perpendicular to said rocker member and to the pivot axis of said rocker member.

2. A circular knitting machine according to claim **1**, wherein each one of said cam discs performs one rotation in the period of time during which said parts move relatively to said respective guide faces by a path length which is equal to the spacing between two parts of the same group.

3. A circular knitting machine according to claim 1, wherein said cam discs for said magnet armatures of all electromagnetic means are rigidly attached to a common shaft and are so offset relatively to each other always by the same angle that a uniform distribution over the circumference is obtained.

4. A circular knitting machine according to claim 3, wherein said rocker members have a common pivot axis which extends parallel to said axis of said cam discs.

5. In a circular knitting machine a Jacquard patterning device which comprises read-out device for reading out information relating to a pattern, and a selection device, the machine having needles and parts associated with said needles for displacing selected needles, displaceable guide faces being provided for moving said parts into an operative position in which they can affect the needles, or into a rest position in which they remain without effect upon said needles, said device comprising a plurality of electro-magnetic means controlled by said read-out device, each of said electro-magnetic means being operatively associated with one of said displaceable guide faces to retain said guide face in one of said positions, each guide face being arranged to control a group of said parts, the said parts of each group being separated from each other by a number of parts associated with other groups, said number being smaller by one than the number of electro-magnetic means, said displaceable guide faces and said parts being arranged for mutual relative movement and said guide faces being staggered transversely to the direction of said relative movement, said parts being provided with control faces which are staggered in a similar manner and which are arranged to come into engagement with respective associated displaceable guide faces, each one of said adjustable guide faces being connected to a magnet armature which is arranged to be guided mechanically by a mechanical drive to poles of the associated electro-magnetic means, said adjustable guide face being disposed at one end of a rod at the other end of which rod said magnet armature is disposed, said mechanical drive of said magnet armature and of said adjustable guide face connected to the latter being derived from a cam disc, the movement transmission from said cam disc to said rod supporting said magnet armature being effected by a rocker member one end of which follows the shape of said cam disc, and the other end of which is in connection with said rod, said rod being disposed approximately perpendicular to said rocker member and to the pivot axis of said rocker member, said rod being provided with a cross pin which extends approximately parallel to said pivot axis of said rocker member and which engages into a slot which is provided in the region of the end of said rocker member adjacent to said rod.

6. A circular knitting machine according to claim 5, wherein said end of said rocker member adjacent to said rod is in the form of a fork with two branches and the two branches of said fork are each provided with a slot.

7. A circular knitting machine according to claim 5, wherein said slot in said rocker end is disposed relatively to said cross pin in such manner that during the movement, derived from said cam disc, of said magnet armature to said poles of said electromagnetic means said cross pin comes to rest at the end of the slot remote from said magnet armature and transmits the movement by contact with the face limiting the end of said slot.

8. In a circular knitting machine a Jacquard patterning device which comprises read-out device for reading out information relating to a pattern, and a selection device, the machine having needles and parts associated with said needles for displacing selected needles, displaceable guide faces being provided for moving said parts into an operative position in which they can affect the needles, or into a rest position in which they remain without effect upon said needles, said device comprising a plurality of electromagnetic means controlled by said read-out device, each of said electromagnetic means being operatively associated with one of said displaceable guide faces to retain said guide face in one of said positions, each guide face being arranged to control a group of said parts, the said parts of each group being separated from each other by a number of parts associated with other groups, said number being smaller by one than the number of electro-magnetic means, said displaceable guide faces and said parts being arranged for mutual relative movement and said guide faces being staggered transversely to the direction of said relative movement, said parts being provided with control faces which are staggered in a similar manner and which are arranged to come into engagement with respective associated displaceable guide faces, each one of said adjustable guide faces being connected to a magnet armature which is arranged to be guided mechanically by a mechanical drive to poles of the associated electromagnetic means, said adjustable guide face being disposed at one end of a rod at the other end of which rod said magnet armature is disposed, said mechanical drive of said magnet armature and of said adjustable guide face connected to the latter being derived from a cam disc, the movement transmission from said cam disc to said rod supporting said magnet armature being effected by a rocker member one end of which follows the shape of said cam disc, and the other end of which is in connection with said rod, said rod being disposed approximately perpendicular to said rocker member and to the pivot axis of said rocker member, a release spring being provided which is supported on the one hand at said rod and on the other hand at said rocker member and which exerts a force which tends to separate said magnet armature from the magnet poles of said associated electromagnetic means, the force exerted by said release spring being smaller than the force required for pulling the magnet armature off said poles when said electromagnetic means is energized.

9. A circular knitting machine according to claim 8, wherein said one rocker member end rests on said cam disc under the effect of a rocker spring.

10. In a circular knitting machine a Jacquard patterning device which comprises read-out device for reading out information relating to a pattern, and a selection device, the machine having needles and parts associated with said needles for displacing selected needles, displaceable guide faces being provided for moving said parts into an operative position in which they can affect the needles, or into a rest position in

which they remain without effect upon said needles, said device comprising a plurality of electromagnetic means controlled by said read-out device, each of said electromagnetic means being operatively associated with one of said displaceable guide faces to retain said guide face in one of said positions, each guide face being arranged to control a group of said parts, the said parts of each group being separated from each other by a number of parts associated with other groups, said number being smaller by one than the number of electromagnetic means, said displaceable guide faces and said parts being arranged for mutual relative movement and said guide faces being staggered transversely to the direction of said relative movement, said parts being provided with control faces which are staggered in a similar manner and which are arranged to come into engagement with respective associated displaceable guide faces, each one of said adjustable guide faces being connected to a magnet armature which is arranged to be guided mechanically by a mechanical drive to poles of the associated electromagnetic means, said adjustable guide face being disposed at one end of a rod at the other end of which rod said magnet armature is disposed, said mechanical drive of said magnet armature and of said adjustable guide face connected to the latter being derived from the cam disc through a rocker member, said cam disc holding said rocker member during approximately three-quarter rotation of said cam disc in a position in which said magnet armature is guided by surface contacting against said poles of said electro-magnetic means and said rocker member being held during approximately one-quarter rotation in a position in which said magnet armature is releasable from said poles with the assistance of the force of a release spring.

* * * * *