United States Patent

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[33] **Germany**
[31] **P 17 88 027.2 and P 19 12 841.7**

[54] **PROGRAM CARD**
12 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **235/61.12,** 234/89, 156/502
[51] **Int. Cl.** **G06r 19/00**
[50] **Field of Search** 235/61.12; 52/519, 526, 535; 156/502; 178/111; 234/89

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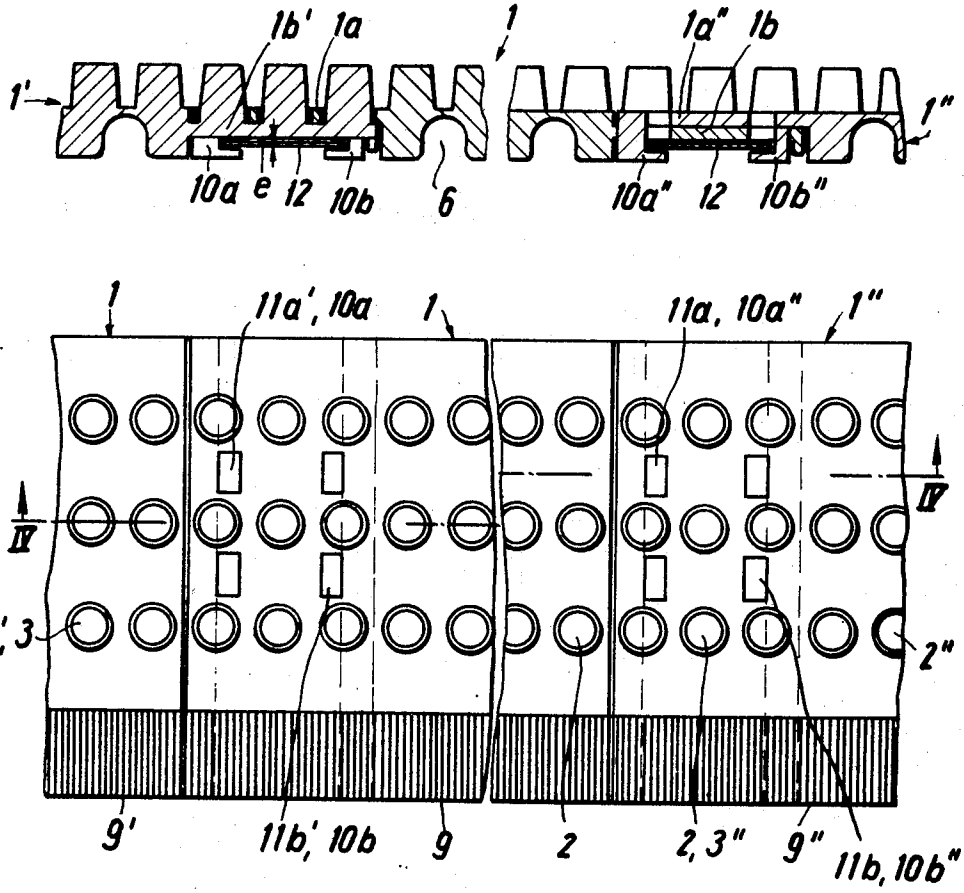
ABSTRACT: Program cards having projections extending from one surface are formed so that they can be interconnected in the longitudinal and transverse directions to provide a continuous member of increased length or width. Corresponding edges of the cards are reduced in thickness and are provided with projections on one and perforations in the other so that they can be joined together with the overall thickness of the joined edges being equal to the normal thickness of the card. To increase the flexibility of the card, the surface which does not contain the projections is provided with recesses which extend transversely of the longitudinal direction of the card. In addition, a rack is formed along one edge of the cards to assist in moving the cards through the control apparatus. A clamping strip can be used to assist in joining cards together.



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SHEET 1 OF 4

Fig. 1b

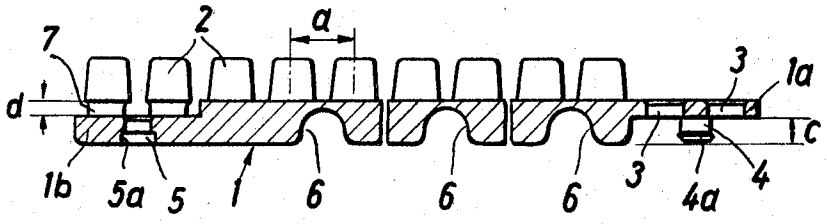

Fig. 1a

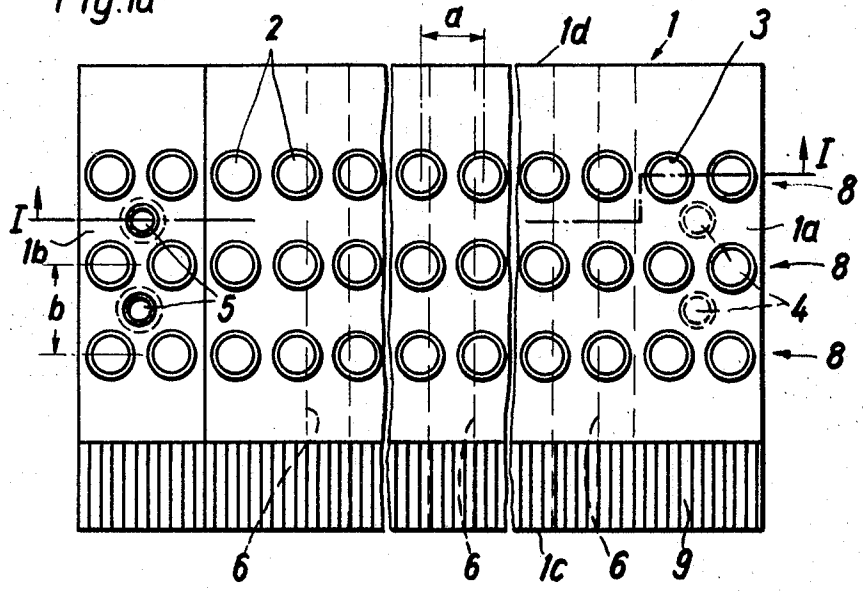

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Fig. 2b

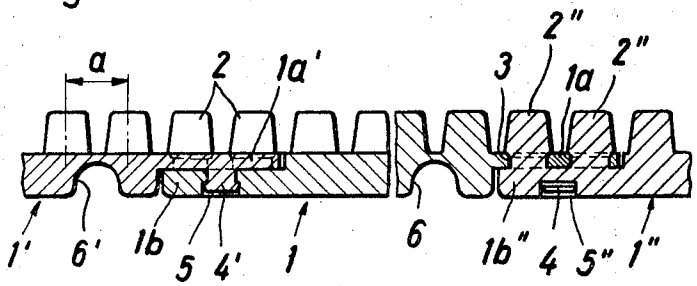

Fig. 2a

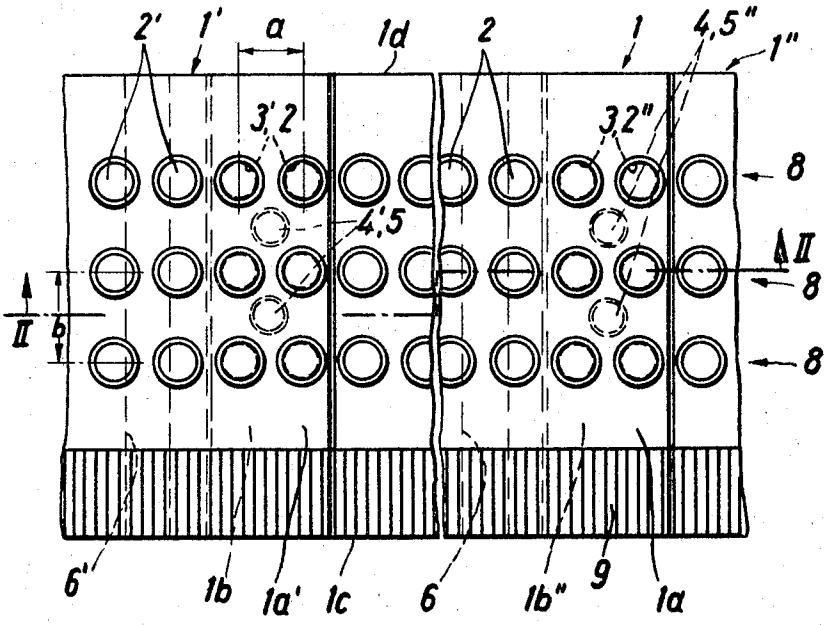

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Fig. 3b

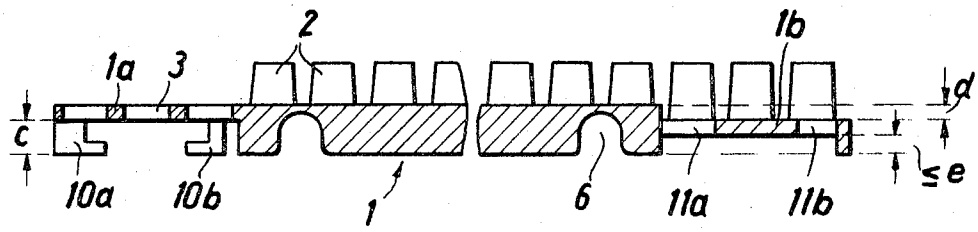

Fig. 3a

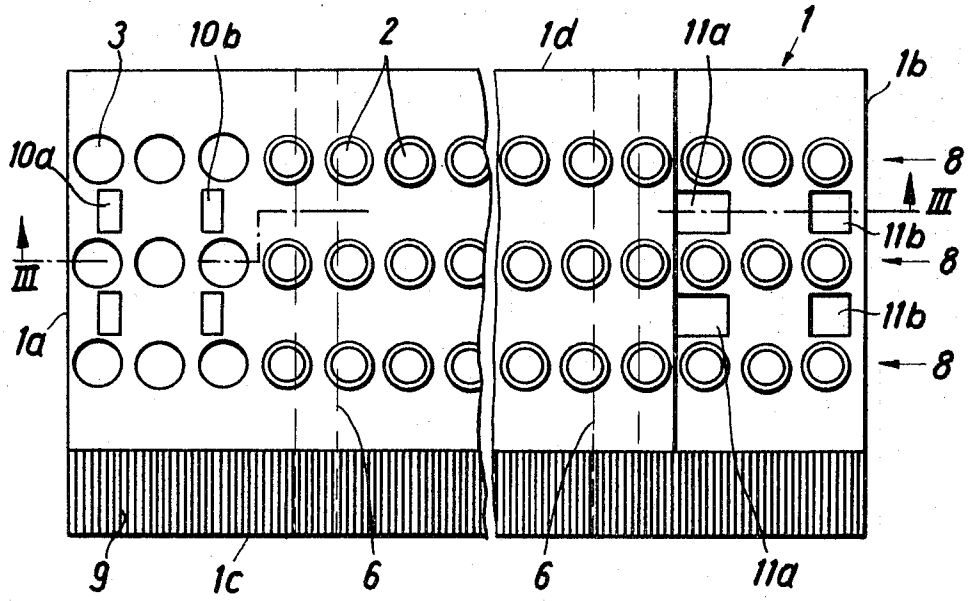

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Fig.4b

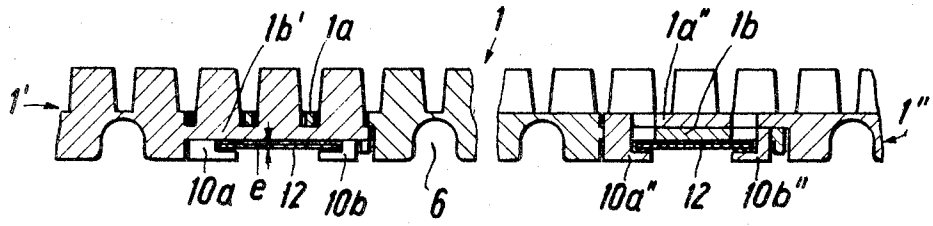
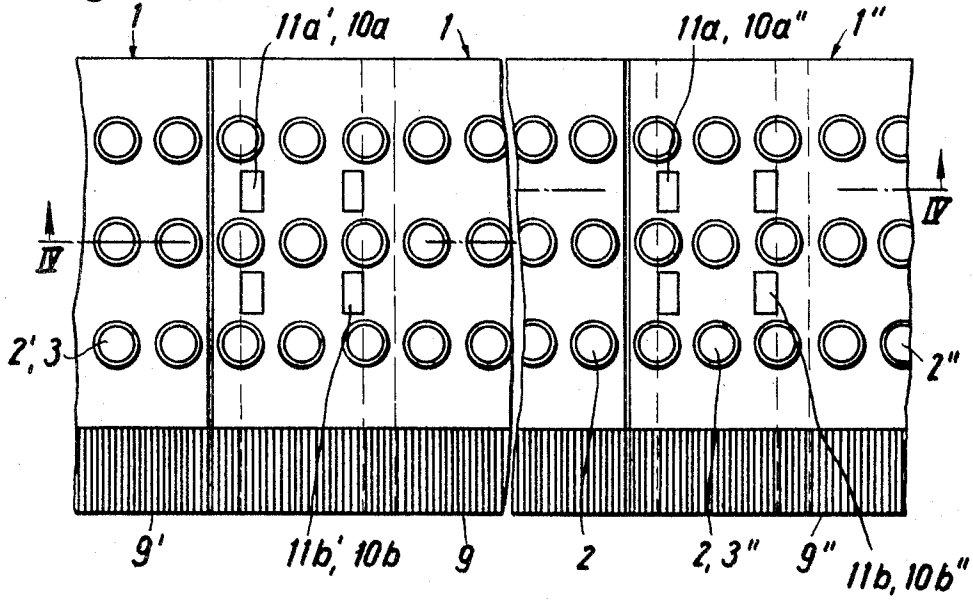


Fig.4a



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PROGRAM CARD

The invention relates to a program card having projections which extend outwardly from the plane of the card, are adapted to be removed for program storage, and follow one another at equal distances along a plurality of tracks parallel to the longitudinal direction of the card.

Such program cards can be programmed in the same simple way as the older punched cards, but as compared with such cards are notable for the fact that they have good shape-retaining properties with any program content, whereas conventional punched cards have only slight inherent stability when they contain a very large number of closely adjacent perforations in their surface.

Therefore, program cards of the type initially mentioned with their program content projecting in relief from the card plane have been shown to be considerably superior to the flat punched cards which have hitherto been most widely used, and therefore have already replaced these flat punched cards for many control purposes. On the other hand, replacement of the flat punched tapes also widely used for control purposes by control strips with a relief program content has hitherto not been successfully effected owing to the difficulties regarding the production of such tapes. For these latter "cards" consist generally of plastic material and therefore can only be manufactured to limited widths and lengths with the conventional machines for plastics processing if the cost is to be kept within tolerable limits.

Therefore, starting from this known state of the art, the invention tackles the problem of providing a program card the program capacity of which can be optionally extended both as regards its width and as regards its length, so that a card of this kind can be regarded as equivalent to a conventional punched tape and, like the latter, permits closing the program content to form a ring.

Proceeding from a program card of the type initially specified, this problem is solved according to the invention in that the card is reduced in thickness, by amounts which together make up the full thickness of the card, at least one edge from below and at the corresponding opposite edge from above in each case over an equal distance corresponding at least to the pitch at right angles to the relevant edge, and the first edge in each case, over an identical distance, comprising instead of the projections perforations which correspond thereto in spacing and cross section.

Thus, the construction of the edge regions of the program card according to the invention provides a possibility of fastening any desired number of identical program cards to one another either at their ends or at their longitudinal sides or at both, and thereby obtaining a tape of optional length and width. A tape of this kind can also easily be joined up to the form a closed ring by fastening the two end program cards together, and it is also possible in the case of an open tape to facilitate the running of the tape into and out of the control apparatus by fastening-on a separate running-in or running-out portion as appropriate at the beginning and end of the tape strip.

According to a further feature of the invention, a particularly reliable fastening of the individual program cards to one another can be obtained by arranging that the projections situated within the edge regions of the card where the thickness is reduced comprise at the region where they issue from the card an encircling recess of a height appropriate to the reduction in the card thickness in these edge regions. This recess has the result that the corresponding edge region of the fastened-on card with its perforations is also retained in the direction towards the free ends of the projections, and accordingly is also secured against displacement in this direction.

A form of embodiment of a program card according to the invention which is very advantageous for the storage of even very long program tapes can be obtained according to a further feature of the invention by providing the rear side of the cards, remote from the projections, at least in the region of

the edges thereof with recesses which are arranged parallel to or at right angles to the projection track. These recesses, which it is most convenient to provide with a semicircular cross section, improve the flexibility of the individual cards at right angles to their plane and thus facilitate the rolling of the fastened-together cards to form a roll of the smallest possible diameter.

Toothed-wheel drives are often used for moving the program cards in the control apparatus, so that the program cards themselves must be provided at least on one of their sides with a rack parallel to the projection tracks arranged longitudinally of the cards. In a card of this kind it is expedient to adapt the steps which exist between card regions of different thickness and extend at right angles to the projection tracks and therefore to the rack as regards their position to the pitch of the rack provided for advancing the cards, in order to avoid these steps causing disturbances during card feed in all cases.

The programming of the program cards adapted to be fastened together according to the present invention is carried out in just as simple a manner as in the case of the hitherto known cards which cannot be joined together, and as regards the program capacity there is, even in the edge regions of the card which have been changed according to the invention, simply the simple limitation that in the card edge regions which are reduced in thickness from above at least a few projections must remain after the cards have been programmed.

If it is desired to dispense with even this slight limitation as regards program capacity, this can be achieved according to a further development of the invention in that between the perforations in the card edge regions reduced in thickness from below there are arranged studs which are directed in the direction opposite to the projections and in height correspond to the reduction in card thickness, and to which there correspond holes of the same cross section provided in the associated card edge regions which are reduced in thickness from above. These studs and bores then permit two cards to be fastened together even if the projections are completely removed in the edge region of a card reduced in thickness from above in the course of programming, so that actually any desired program can be fed into the card.

To improve the reliability with which two cards can be fastened together, it is also recommended to provide the studs terminally with bevelled heads of relatively large diameter and to increase the internal clear width of the holes at the corresponding regions, whereby, after the cards are fastened together, the studs are secured against any displacement at right angles to the card plane in both directions.

For solving the problem according to the invention, in addition to the possibility of easy fastening of several individual cards to form an optionally wide or optionally long large-sized card, the possibility of detaching individual cards again from the composite assembly and possibly replacing them by differently programmed individual cards is also of great importance. Both the fastening capability for the individual cards and their ability to be separated from one another are to be such that they can be effected without the least limitation as regards programming possibilities available to individual cards. It is an important point to provide fastening facilities which even with not very strong card materials and very thin cards can be released optionally and often without causing any damage.

According to yet a further development of the invention, this object is achieved in that between the perforations hook-shaped protuberances directed in the direction opposite to the aforesaid projections and with a height corresponding to the reduction in card thickness in these edge regions are so arranged in pairs in the card edge regions reduced in thickness from below that their open sides are directed towards one another and a flat clamping strip extending preferably over the entire width or length of the card can be inserted between them, and that the associated card edge regions reduced in thickness from above comprise at the corresponding regions apertures which have an internal clear width corresponding to

the largest cross section of each protuberance, and, therebetween, are reduced in thickness from below by an amount equal to at least the thickness of the clamping strip.

When several program cards are joined together in this way to form a large-size card, the protuberances on the underside of one card are fitted into the apertures in the appropriate edge region of the neighboring card until the two individual cards are both situated in the same plane, and then there is inserted between the protuberances of one card a clamping strip which runs under the apertures in the other card over possibly the entire width or length thereof and thus reliably prevents separation of the two individual cards from one another. To release the two individual cards from one another, it is then simply necessary to remove this clamping strip, and the two individual cards can be readily removed from one another since between the protuberances on one card and the apertures in the other card there is no need for any frictionally locking connection to exist. Thus the construction of the program cards according to the invention reliably excludes the possibility of damaging any card parts when separating from one another individual cards which have been connected together.

For the production of the clamping strip it is possible to use all materials which at least have a certain amount of inherent stiffness, and more particularly it is possible to produce the strips from plastic material so that the clamping strip and program card can be made from the same material. On the other hand, if the clamping strip is to be made of metal, it should, in order to facilitate the programming of individual cards already fastened to one another, which is most easily carried out by means of a kind of perforating pincers, comprise at the regions corresponding to the card projections to be removed in programming, apertures of an internal clear width equal to the cross section of these projections.

As a safety measure against accidental detaching of the clamping strip from the joined-together cards, the clamping strip can be provided with at least one protuberance or aperture which can come into engagement with a corresponding aperture or protuberance on a card. This also secures the clamping strip against accidental displacement in its longitudinal direction.

For further explanation of the invention, some examples of embodiments of program cards constructed according to the invention will now be described in more detail, these being illustrated in the drawings wherein:

FIG. 1*a* shows a plan view of a single program card according to a first form of embodiment of the invention;

FIG. 1*b* shows a longitudinal sectional view through the card of FIG. 1*a* along the section line I–I of FIG. 1*a*;

FIG. 2*a* shows a plan view of the fastening regions of three program cards constructed in accordance with FIGS. 1*a* and 1*b*;

FIG. 2*b* shows a longitudinal section, similar to FIG. 1*b*, through the fastening regions of the cards in FIG. 2*a* along the section lone II–II of FIG. 2*a*;

FIG. 3*a* shows a plan view of a single program card according to a second form of embodiment of the invention;

FIG. 3*b* shows a longitudinal sectional view through the card of FIG. 3*a* along the section line III–III of FIg. 3*a*;

FIG. 4*a* shows a plan view of the fastening regions of three program cards constructed in accordance with FIG. 3*a* and FIG. 3*b*; and

FIG. 4*b* shows a longitudinal sectional view similar to FIG. 3*b* through the fastening regions of the cards shown in FIG. 4*a* taken along the section line IV–IV of FIG. 4*a*.

The program card 1 shown in FIGS. 1*a* and 1*b* comprises at its front side a plurality of tracks 8 which extend parallel to its longitudinal direction and project above the card plane, each track consisting of a plurality of projections 2 which succeed one another at equal intervals. The track pitch i.e. the spacing between two tracks 8 calculated in each case from projection center to projection center, has the value*b* and the projection pitch i.e. the spacing between the centers of two projections 2 arranged in succession to one another within a track 8, has the value a.

In the left-hand edge region 1*b* of the card 1 in FIGS. 1*a* and 1*b*, a card is reduced in thickness by an amount *d* from above. The extent of the edge region 1*b* as viewed in the longitudinal direction of the card 1 amounts to twice the projection pitch *a*. The projections 2 situated in the edge region 1*b* of the card 1 each comprise at the place where they issue from the card plane an encircling recess 7 the height of which corresponds to the amount *d* by which the card thickness is reduced in the edge region 1*b*.

In the edge region 1*a* of the card 1 situated at the right in FIGS. 1*a* and 1*b* the card is reduced in thickness from below by an amount *c* the extent of which together with the amount *d* by which the card thickness is reduced in the edge region 1*b* corresponds to the full thickness of the card 1. The edge region 1 *a* is free of projections 2 and comprises instead perforations 3 which correspond to the projections 2 in spacing and diameter. Between these perforations 3 and between the projection tracks 8 there are also provided in the card region 1 *a* studs 4 which are directed downwardly from the rear side of the card i.e. extend in the opposite direction to the projections 2, and at their free end have bevelled heads 4*a* of relatively large diameter. These studs 4 correspond to holes 5 situated in the edge region 1*b* of the card 1 which is reduced in thickness from above, the holes being enlarged correspondingly as regards their internal clear width at the regions 5*a* associated with the heads 4*a* of the studs 4.

Arranged at the rear side of the card are recesses 6 which extend at right angles to the projection tracks 8 and have a semicircular cross section. Additionally along the edge 1*c* of the card 1, a rack 9 is arranged which serves for card feed in cooperation with an appropriate driving mechanism in the control apparatus.

For the sake of simplicity in the drawings, in the example of a program card according to the invention which is illustrated in FIGS. 1*a* and 1*b* a fastening means according to the invention for fastening to similar cards is shown only at the edge regions 1*a* and 1*b* at the ends of the length of the card 1, but it will be apparent that corresponding means according to the invention can equally well be provided in the region of the longitudinal edges 1*c* and 1*d* of the card 1 or both in the edge regions 1*a* and 1*b* on the one hand and in the regions 1*c* and 1 *d* on the other hand, in which case cards are obtained which can be optionally extended both as regards their length and as regards their width.

FIGS. 2*a* and 2*b* show the connecting regions between three successive program cards 1′, 1 and 1″ in plan view and longitudinal section. like parts in all three cards using like reference numerals in each case, only the prime and double prime indicating to which of the three cards the relevant part belongs in each case.

FIG. 2*a* also shows the continuous run of the projection tracks 8 and rack 9 over the three cards 1′, 1 and 1″, whereas the section view in FIG. 2*b* shows the cooperation on the one hand of the studs 4′ in the edge region 1*a*′ of the card 1′ with the holes 5 in the edge region 1*b* of the card 1 and on the other hand of the projections 2″ in the edge region 1*b*″ of the card 1″ with the perforations 3 in the edge region 1*a* of the card 1.

The program card 1 shown in FIGS. 3*a* and 3*b* comprises on its front or upper side a plurality of tracks 8 which extend parallel to its longitudinal direction and project beyond its plane, each track comprising a plurality of projections 2 following one another with the same spacing from one another. In the edge regions 1*a* and 1*b* the card 1 is reduced in thickness, and in fact in the edge region 1*b* of the card 1 which is at the right in FIGS. 1*a* and 1*b* the thickness is reduced from above and in the left-hand edge region 1*a* of the card 1 in FIGS. 3*a* and 3*b* the thickness is reduced from below, to such amounts *d* and *c* respectively that the edge region 1*a* of the one card 1 when applied to the associated edge region 1*b* of a neighboring card with its upper side forms the prolongation of the nonreduced portions of this neighboring card.

The edge region 1*a* is free of projections 2 and in their place comprises in each case perforations 3 which correspond in spacing and diameter to the projections 2. Between these per-

forations 3 and between the projection tracks 8 there are provided in the card region 1*a* hook-shaped protuberances 10*a* and 10*b* respectively which are located on and extend from the rear or bottom side of the card i.e. in the opposite direction to the projections 2, and have their hook-shaped ends facing towards one another. Corresponding to these protuberances 10*a* and 10*b* there are arranged in the edge region 1*b* of the card 1 which is reduced in thickness from above apertures 11*a* and 11*b* respectively whose internal clear width in each case is so dimensioned that the associated protuberance 10*a* or 10*b* of a neighboring card to be fastened to the card 1 can easily be pushed through apertures. Between the apertures 11*a* and 11*b* the card 1 is reduced in thickness from below by an amount which is at least as much as the thickness *e* (visible in FIG. 3*b*) of a clamping strip 12 which is adapted to be inserted between the protuberances 10*a* and 10*b*, as shown in FIG. 4*b*.

In the nonreduced portion of the card 1 there are arranged at the rear side of card recesses 6 which extend at right angles to the projection tracks 8 and have a semicircular cross section and facilitate the rolling of the card 1 to form a roll of small diameter. Also arranged along the edge 1*c* of the card 1 is a rack 9 which serves for card feed in cooperation with a corresponding driving mechanism in the control apparatus to be operated by the program card.

For the sake of simplicity in the drawings, in the example of the embodiment of a program card according to the invention which is shown in FIGS. 3 and 3*b* again a fastening means according to the invention for use with similar cards is shown only in the edge regions 1*a* and 1*b* at the ends of the length of the card 1, but it will be evident that corresponding means according to the invention could equally well be provided in the region of the longitudinal edges 1*c* and 1*d* of the card 1, or both in the edge regions 1*a* and 1*b* on the one hand and in the edge regions 1*c* 1*d* on the other hands, giving program cards which can be optionally extended both in the sense of their length and in the sense of their width.

FIGS. 4*a* and 4*b* again show the connecting regions between three successive program cards 1', 1 and 1'' in plan view and longitudinal section, like reference numerals being used to designate like parts of all three cards, it being simply indicated by the prime or double prime in each case to which of the three cards the relevant part belongs.

FIG. 4*a* shows the continuous run of projection tracks 8 and rack 9 over the three cards 1'FIG. 1 and 1'', whereas the section view shown in FIG. 4*b* shows the cooperation on the one hand of the protuberances 10*a* and 10*b* in the edge region 1*a* of the card 1 with the apertures 11*a'* and 11*b'* respectively in the edge region 1*b'* of the card 1' and the clamping strip 12 on the other hand which is inserted between the protuberances 10*a* and 10*b*, and also the appropriate conditions at the connecting region between cards 1 and 1''.

I claim:

1. A longitudinally extending program card having an upper plane surface and a lower plane surface spaced apart by a predetermined thickness, said card having a pair of longitudinal edges and a pair of transverse edges and each of said longitudinal and transverse edges said oppositely an upper surface and a lower surface, a plurality of projections extending outwardly from said upper plane surface with said projections being spaced apart at equal intervals in the longitudinal direction and in the transverse direction and being aligned in tracks disposed in parallel relationship with the longitudinal edges of said card, wherein the improvement comprises at least one pair of said pairs of longitudinal and transverse edges having a reduced thickness with a combined thickness of the reduced thickness of said edges being equal to the predetermined thickness of said card, the widths of the reduced thickness of said oppositely disposed edges being the same and being equal to at least the spacing between two adjacent said projections in the direction of the width of said edges, one of said reduced thickness edges having said projections extending outwardly therefrom and the other said edge having perforations therethrough disposed in the same spacing as said projections and the openings formed by said perforations being arranged to receive said projections therein so that a number of said crads can be interconnected along their longitudinal or transverse edges for selectively increasing either the total length or width or both of the surface containing said projections.

2. A program card, as set forth in claim 1, wherein said projections located along said reduced thickness edge of said card have an annular recess at the base thereof adjacent the surface of said reduced thickness edge and the height of the recess in the direction of the projection corresponding to the difference between the reduced thickness of said edge and the predetermined thickness of said card.

3. A program card, as set forth in claim 1, wherein a plurality of longitudinally spaced transversely extending recesses are formed in the lower plane surface of said card.

4. A program card, as set forth in claim 3, wherein said recesses have a semicircular cross section.

5. A program card, as set forth in claim 1, wherein at least one rack is formed along one edge of said card extending in parallel relationship with an aligned track of said projections, the width of said reduced thickness edges extending transversely of said rack being equal to a multiple of the pitch of said rack for avoiding disturbances during the card feed utilizing said rack.

6. A program card, as set forth in claim 1, the upper surface of one of said reduced thickness edges being in the plane of the upper surface of said card and the lower surface of the other oppositely disposed said reduced thickness edge being in the plane of the lower surface of said card, studs formed on the lower surface of said reduced thickness edge having its upper surface in the plane of the upper surface of said card and said edge having said studs extending therefrom having said perforations formed therethrough with said studs being spaced between said perforations, said studs having a height which in combination with the thickness of said reduced thickness edge from which the stud extends equals the predetermined thickness of said card, and the oppositely disposed said reduced thickness edge of said card having said projections with said annular recesses extending upwardly from the upper surface thereof which is spaced from the upper surface of said card, and openings spaced between said projections and having the spacing thereof corresponding to the spacing of said studs on the oppositely disposed said reduced thickness edge so that said studs fit into said openings in another said card for assisting in joining said cards together.

7. A program card. As set forth in claim 6, wherein the outer ends of said studs spaced from the surface of said reduced thickness endges from which they project are bevelled and have a larger diameter than the remaining shank of said stud and said holes in the oppositely disposed said reduced thickness edge having a correspondingly larger annular portion for receiving the bevelled end of said studs.

*. A program card, as set forth in claim 1, the upper surface of said one reduced thickness edge being in the plane of the upper surface of said card and the upper surface of the other said reduced thickness edge being spaced from the upper surface of said card, the upper surface of said other reduced thickness edge having a plurality of said projections extending upwardly therefrom, the upper surface of said reduced thickness edge located in the plane of the upper surface of said card having a plurality of said perforations therethrough, a plurality of hook-shaped protuberances extending downwardly from the lower surface of said reduced thickness edge having said perforations therethrough, each pair of said hook-shaped protuberances disposed in facing relationship each providing an inwardly directed flange facing the other and the height of said hook-shaped protuberances in combination with the thickness of said reduced thickness edge from which they project being not greater than the predetermined thickness of said card, the other said reduced thickness edge having openings therethrough through which said hook-

shaped protuberances may extend, and a flat longitudinally extending clamping strip arranged to be inserted between the flanges formed by said hook-shaped protuberances and the lower surface of the other said reduced thickness edge for clamping two of said cards together and the lower surface of said other reduced thickness edge being spaced from the lower surface of said card by a dimension at least greater than the thickness of said clamping strip.

9. A program card, as set forth in claim 8, wherein said clamping strip is made of a plastic material.

10. A program card, as set forth in claim 8. wherein said clamping strip is made of metal and the portions thereof aligned below said projections in said card have openings whose minimum diameter is equal to the cross sectional diameter of said projections.

11. A program card, as set forth in claim 8, wherein a protuberance extends outwardly from said clamping strip, an opening in said card being arranged to receive said protuberance on said clamping strip.

12. A program card, as set forth in claim 8, said clamping strip having an opening therein, a protuberance extending from said card and arranged to engage within the opening in said clamping strip for avoiding any accidental detachment of said clamping strip from its position securing said cards together.