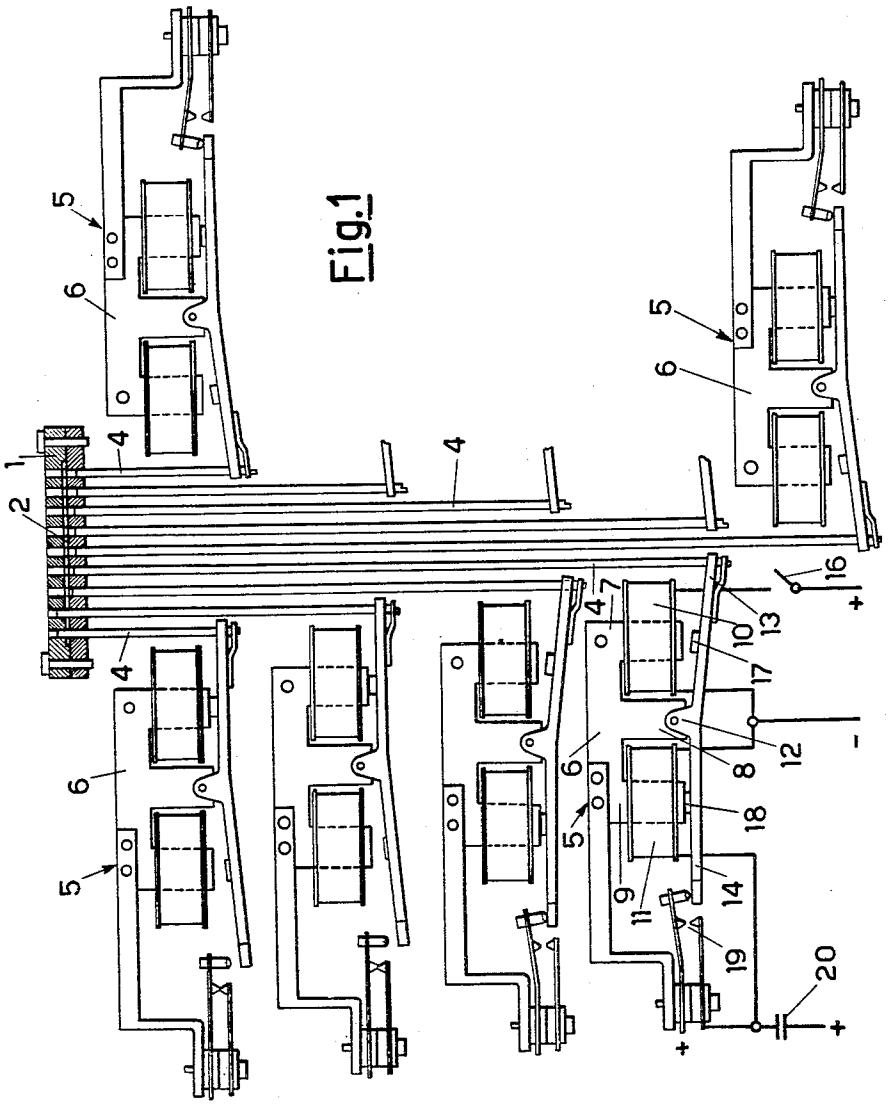
June 26, 1962 V. SVIDERCOSCHI 3,040,610

PERFORATOR FOR TAPES WITH PUNCHES CONTROLLED THROUGH ELECTROMAGNETS

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Fig.1



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Fig.2

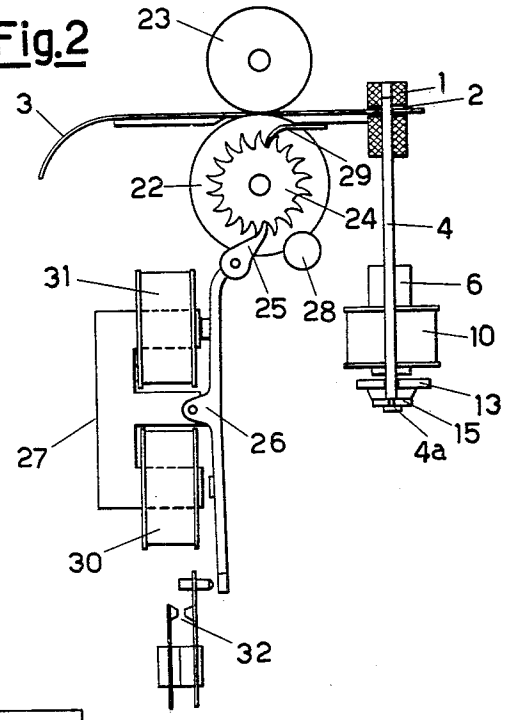


Fig.3

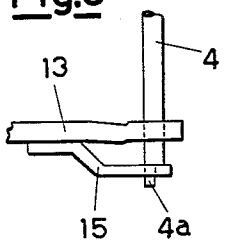
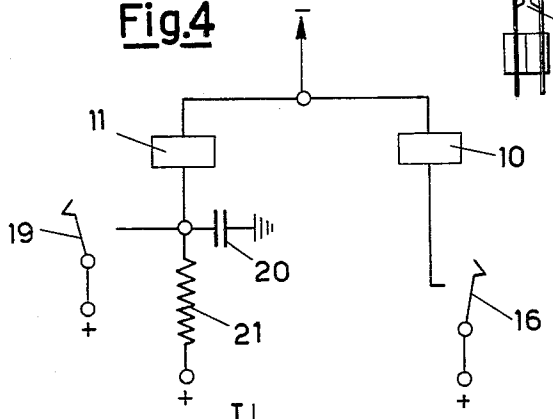


Fig.4



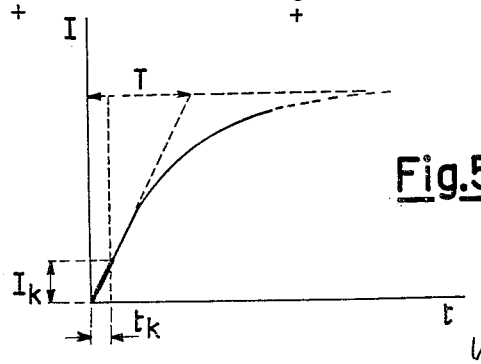


Fig.5

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PERFORATOR FOR TAPES WITH PUNCHES CONTROLLED THROUGH ELECTROMAGNETS

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2 Claims. (Cl. 83—513)

It is known that, with perforators for tapes of common kind, the power necessary for perforation is supplied to the punches by a motor which through linkages displaces said punches to make the holes; the displacement of each punch is carried out as a consequence of the energizing of the electromagnets which with their armature in working position transmit the movement of the linkages, pushed by the motor, to the respective punches.

That means that the punching of every perforation depends on the movement of two different units. It is clear that there must exist a close relationship between the two movements, and that their sequence must be accurately determined: this entails a considerable complication of construction and control, above all if it is desired to attain a high perforating speed.

In order to meet the two fundamental requirements, namely the simplicity of construction and the high perforating speed, it has been suggested to provide a perforator for tapes equipped with electromagnets, each of which is adapted to perforate the tape by means of displacement of a punch directly connected to its own armature.

However the requirement of a high working speed prevented the use of an electromagnet similar to those employed at present with telephone selectors.

According to the present invention an electromagnet is provided wherein the means for the return of the armature after perforation are not constituted by a spring but by a force which is exerted upon said armature, while the latter is displaced to perform the perforation, whereby the force does not hinder to an appreciable extent the rapid displacement of said armature. As will be better explained in the following description, said return force is such as to be initially, during the displacement of the armature in the sense that operates the perforation, not only smaller than the force causing said displacement, but also decreasing with a certain rapidity, while said force causing the displacement that brings about the perforation proceeds to grow rapidly.

The perforator for tapes according to the invention, therefore, is characterized in that it comprises a series of electromagnets, each of which performs the perforation with a punch directly connected to its own armature, the return being obtained by electromagnetic means which preferably start action towards the end of the working stroke of said armature, exerting thereupon a decreasing force of attraction.

An example of embodiment of a perforator according to the invention will be described hereinafter, with reference to the accompanying diagrammatical drawing, wherein:

FIG. 1 shows an assembly view of the perforator; FIG. 2 shows the device for the transport of the tape; FIG. 3 is a detail view showing the attachment of a punch to the armature of the correspondinng electromagnet; FIG. 4 represents a variant of the energizing circuit for one of the electromagnets, and FIG. 5 is a graph relative to a possible embodiment of an electromagnetic device for controlling a punch.

In the example of FIGURE 1 there is indicated diagrammatically a perforator equipped with eight punches which serve for the perforation of service signals, and with a ninth perforator which perforates the so-called dragging track. The perforator comprises essentially a perforating matrix **1** with a slot **2** within which there comes to slide the tape **3** to be perforated (see FIG. 2). Each punch **4**, as will be described hereinafter, is connected directly to the armature of one of the electromagnetic device, generically indicated by **5**. In the drawing there are represented only some of those electromagnetic devices and the following explanation relates to any one thereof, all the other being completely identical in structure as well as in operation.

Each electromagnetic device **5** comprises a core **6** of soft iron in the shape of an E on the extreme extensions **7** and **9** whereof there are placed two coils **10** and **11**.

On the central extension **8** of said core **6** there is hinged an armature **12** with two arms **13**, **14**, which is connected, through the arm **13**, to a punch **4** adapted to make a row of perforations in the tape **3**. FIGURE 3 indicates diagrammatically the attachment of said punch **4** to said armature **12**; it shows that the punch **4** is accommodated in a slot of the armature.

A small shaped plate indicated by **15** is fixed to the arm **13** of the armature **12** and retains the punch **4** by means of a slot through which an extension **4***a* of said punch passes.

The working coil **10** which causes the perforation is connected to a source of current (+, —) through a contact **16**. On closing said contact **16**, an electric current of adequate intensity passes through the coil **10**.

A force is generated thereby which acts upon the arm **13** of the mobile armature, thereby compelling said armature to turn around its fulcrum in such a way that said arm **13** approaches the core of said coil **10**. An insulating plate **17** is carried by the arm **13** thereby preventing a direct contact between the arm **13** and the core of the coil. On rotation of said armature, at a certain time the end of its arm **14** permits the closure of a contact **19** which sends the current of the source to the coil **11** so that this second coil becomes energized and there is exerted a corresponding magnetic return force upon the arm **14** of the armature **12**.

The coil **11** has such characteristics of structure and feed that upon the arm **14** there is exerted said force for returning the anchor, namely, a force tending to oppose the rotation previously started, however this force is such as not to hinder seriously said rotation which causes the arm **13** to approach the core of the coil **10**.

It should be noted here that while said rotation continues, the force acting upon the arm **13** increases rapidly while that acting upon the arm **14** diminishes also rapidly, this latter arm moving away from the core of the coil **11**. Consequently said armature, towards the end of its own rotation, possesses a high speed and, therefore, the punch **4**, carrying out the perforation, comes to possess, at the time of said perforation, a considerable kinetic energy.

If, however, when the perforation has been terminated, the contact **16** is re-opened, the force generated by the coil **11** returns said armature to its rest position; in performing said return movement, the end of the arm **14** causes again the opening of the contact **19**, and thereby interrupts the energization of the coil **11**. The arm **14** of the armature **12** rests in its rest position on the core of the coil **11** through an insulating plate **18** similar to the plate **17** on the arm **13** but thinner.

In parallel to the contact **19** there is provided a condenser **20** which besides acting as an arcing contact, prolongs the energization of the coil **11** thereby ensuring the return of the armature **12** to rest position.

The invention also provides an embodiment adapted to moderate considerably the braking action of the coil **11**. Said braking action in fact becomes substantial when the intensity of the current in the coil **11** has attained the stationary value, a certain length of time after the closing of the contact **19**. Said length of time is greater than the so-called time constant of the coil **11** and increases with the increase of said time constant.

To prevent the closing of the contact **19** from exerting a substantial braking action upon the anchor **12**, the coil **11** can be dimensioned in such a way that its time constant T is substantially greater than the time interval between the closing of the contact **19** and the arrival of the armature **12** at the end of stroke under the action of the coil **10**.

In the graph of FIG. 5 there is indicated the course of the intensity I of the current in the coil **11** as a function of time *t*. By t_k is indicated the time that elapses between the closing of the contact **19** and the arrival of the armature, under the action of the coil **10**, at the end of stroke; by I_k is indicated the intensity of the current in the coil **11** at the time at which the armature **12** arrives at the end of stroke. In the case of FIGURE 5 one gets: $T=5.t_k$, that is, the time constant T of the coil is five times the time t_k. From the course of the current as a function of time one realizes instantly that the value I_k attained by the current in the coil **11** at the end of the active stroke of the armature, is in that case really negligible if one considers moreover that the gap at the coil is a maximum at that time.

According to a possible different embodiment, of considerable importance, the coil **11** is energized permanently by a weak current, through a resistor **21** according to the diagram indicated in FIGURE 4.

Said current will have to be adjusted in such a way as to be able to retain safely the armature in rest position, preventing any possible recoils of said armature.

However said rest current has a very small value because the respective magnetic circuit possesses a particularly low reluctance since the insulating plate **18** inserted between the arm **14** of the armature **12** and the core of the coil **11**, is very thin.

The force due to this weak rest current not only ensures a stabile rest position of the armature **12**, but also prevents the latter from moving until the flux generated by the coil **10** by effect of the closing of the contact **16** has attained a predetermined value; as will be better explained hereinafter, that appears to be of particular interest.

In fact, in the case in which the coil **11** is not passed through by the rest current, if the coil **10** is energized, the armature **12** starts its movement soon, being attracted by the coil **10** and, therefore, there very soon occurs the so-called "anchor effect," owing to which the current diminishes in the coil **10**. As a consequence the punch **4** controlled by the anchor **12** strikes against the paper tape **3** to be perforated with an energy which may be insufficient for perforation: at that time, when the armature stops, the "anchor effect" ceases and, therefore, the intensity of the current in the coil **10** begins to rise again, whence after some instants the perforation is finally performed. So at least part of the kinetic energy stored by the armature and by the punch is wasted.

If instead the coil **11** is constantly passed through by a rest current, if the coil **10** is energized said rest current prevents at the beginning the rotation of the armature **12**. While the armature remains at a standstill, the "anchor effect" is lacking, so that the current in the coil **10** can increase in intensity.

At a certain time, the intensity of said current in the coil **10** comes to be such as to cause the rotation of the armature **12** thereby overcoming the opposition of the coil **11** due to the rest current: on starting said rotation, the "anchor effect" occurs, it is true, but, since the current in the coil **10** is by now sufficiently high, the punch **4** arrives at the paper tape **3** with an energy sufficient to perform the perforation. It should be noted that in the present case (with rest current in the coil **11**) the whole energy of the punch **4** becomes available to perform the perforation of the paper while in the case in which there is no rest current in the coil **11**, the punch **4** comes to stop upon contact with said paper, losing in practice its energy and it has, therefore, to perform the perforation by starting again from standstill.

From what has been set forth hereinbefore it appears that while it is at any rate possible to obtain the perforation also without the rest current in the coil **11**, by employing for the purpose a certain time, said perforation is obtained in a much shorter time in the case in which in the coil **11** there is said rest current. This is of considerable advantage in view of the work required to be done by perforators.

In FIG. 2 there is diagrammatically represented the electromagnetic device for the transport of the tape **3**. In said figure there are represented two rolls **22** and **23** between which there is dragged the tape **3**, a toothed wheel coaxial and rigid with the roll **22**, a thrust pawl **25** which is hinged at the armature **26** of the dragging magnet **27** and is adapted to mesh between the teeth of the wheel **24**, while a stop **28**, rigid with the support of the magnet **27** is adapted to limit the stroke of the pawl **25**; a spring **29** serves to prevent the opposed rotations of the roll **22**.

When the coil **30** of the magnet **27** attracts the armature **26** towards it, the pawl **25** causes the roll **22** to perform a partial revolution. As a consequence thereof, the latter, in cooperation with the roll **23** pressing towards the roll **22**, determines a displacement of the tape **3** gripped between the two rolls.

In its rotation a second arm of said anchor **26** moves to close the contact **32** and, therefore, to energize the coil **31** of the electromagnet **27** whereby, if the coil **30** is deenergized, the coil **31** returns the armature **26** to its rest position; during said return the spring **29** keeps the roll **22** fixed. The operation and the electric connection of the electromagnet **27** correspond to those of the electromagnets described with reference to FIG. 1.

While the adoption of an electromagnet **27** of the type described is advantageous thanks to its simplicity and quickness in operation, the forwarding of the tape **3** to be perforated might be controlled with any other known means.

It is possible to realize, according to the present invention, also electromagnetic devices for accomplishing the perforations, wherein the return of the armature connected to the punch **4**, takes place through the same rest current which constantly passes through the coil **11** (FIG. 4), namely without the other current which in the examples described hereinbefore, starts action on the closing of the contact **19**.

I claim:

1. A perforator for tapes, said perforator comprising a plurality of punches having tape-perforating ends, a separate electromagnetic device for each punch, each electromagnetic device comprising a core having a central portion and two opposed extensions, an armature swingably mounted upon said central portion and having two opposed arms extending adjacent said extensions, a separate coil upon each extension, means operatively connecting an end of one of said arms to a separate punch, a contact connected with an end of one of said coils, another contact connected with an end of the other one of said coils, means conductively connecting other ends of said coils to a terminal of a source of electrical energy, means conductively connecting said contacts to another terminal of the source of electrical energy and perma-

iently maintaining a weak current in said other coil, an insulating plate carried by said one arm and adapted to engage said one coil when said one arm is attracted by said one coil to actuate the punch, and means connected with said other contact and actuated by said other arm for closing said other contact and thereby fully energizing said other coil after said one arm has been attracted by said one coil.

2. A perforator in accordance with claim 1, wherein the third-mentioned means comprise a resistor connected to said other terminal and to said other contact.

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