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Investigations into the Improvement of Electric Pig Stunning Technics.

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Stunning technique, although applied for the last 30 years in slaughterhouse practice, has not yet achieved its final form.

After the thorough investigation of CO_2 immobilization technique and the adoption thereof to Hungarian conditions, it was felt necessary to study electric stunning. The Hungarian Meat Research Institue propsed to work out suitable stunning equipment and pertaining technology of the known stunning systems. Elthers tool stuns with a single shock. According to Garnich this method saves time but because of the convulsions following stunning, the bleeding is difficult. W.Seehafer mentions that the apparatus needs a qualified person to handle.

Several research workers, P.G. Croft, M. Cirio and R. Tadio find on the basis of experience suffered by men, who received electric chock, that it causes only immobilization without alleviating pain.

With apparatus available at present for electric stunning, humane slaughter may hardly be achieved, however with higher

frequency and other suitable parameters it seems to be possible.

The parameters to be considered when electric current is applied are as follows:

1. voltage
2. amperage
3. frequency
4. modulation
5. time.

Data as described in related literature are rather inconsistent and no unambiguous conclusions may be drawn from them. When a current of main frequency is applied, it is generally of sine character and stunning is executed with the voltage stepped down with a transformer. This is the most obvious and simple method. In this method apart from time, the voltage is predetermined and given as characteristic parameter.

In the opinion of the authors the amperage is the most important characteristic and not voltage. Voltage is of importance of the animal. Since the bodily resistance of the animal may vary between 100 and 2000 , at constant voltage, amperage may vary to the same extent. If electrods are placed behind the ears, the average resistance may amount to 400 .

In Table 1 the data found in related literature and as applied in three Hungarian slaughterhouses are shown. As may be seen parameters show much deviation. The case becomes much simpler when the problem is examined as a function of amperage and time. In applying amperage multiplied by time, termed in electrotechnics quantity of charge, and marked Q/its unit being= ampersecundum/ /the quantity of charge may be plotted against time /Figure 1./.

The quantity of charge values, as shown in Figure 1 give a much better correspondence and fall between 1 and 2 ampersecundums. The only exeeption are the Danish data, given by S.V.M. Blomquist. However these data may also fit the line when the stunning technique as applied is taken into consideration. Stunning is done by forceps applied behind the ears of the animal and moved to the eyes increasing thereby the effect.

The conclusions drawn of Figure 1. expressed in words are as follows: to achieve good stunning results, a certain quantity of charge is necessary or if higher amperage is applied relatively less quantity of charge, i.e. less stunning time is needed.

Further variation may be achieved by varying frequency and waveform. In the praxis so far, mostly main frequency of 50 or 60 herz sine wave current has been applied.

It siems that as far as wave form is concerned, the rec. tangular form is the most effective.

It was concluded that to carry out decisive experiments, a special equipment was needed. For this purpose the apparatus as shown in Figure 2. was constructed.

The apparatus is substantially an inverter with transistor supplied from a direct current supply unit. The voltage of the supply unit and in proportion to this the voltage of the current used actually for stunning may be varied within wide limits. The transformed inverter controlled at the power stage is supplied by this direct-alternation. The power stage is at present a sine wave generator with variable voltage and amperage. The frequency of the inverter will correspond to that obtained in the generator. By changing the voltage of the power stage of the inverter, the wave form of the stunning current may be controlled. The wave form as shown in Fig. 3. may be of sine, trapezium or square character.

For the time being experiments were carried with square wave current. The frewquency of the current may be varied continuously between 50 - 5000 Hz.

The statical characteristics in the case of constant stunning current and varied maximum stunning voltage as obtained with the apparatus are shown in Figure 4a. Figure 4b gives the

characteristics in the case of constant voltage and varied stunning current. Within the operational range to each voltage any desired current value may be applied.

Figure 4 shows that the current controller does not intervene within the predetermined current value. When however the predetermined maximum current value, is reached, a signal is given to decrease or at border conditions to interrupt electric current. To control the apparatus, the following parameters have to be determined

a/ the frequency of the power stage,

b/ the stunning voltage,

c/ the stunning amperage,

at the same time the wave form is controlled with the oscilloscope. Thus all paramters may be reproduceably controlled.

This electric stunning equipment is built into the experimental slaughter-line at the Hog Slaughterhouse, Budapest. It is an important feature of the equipment that the pigs to be killed are fixed in the stunning-drum, thereby the electrods are always in the same position and each phase of stunning may be carried out properly.

The first result with the equipment seem better than those obtained with all equipment hitherto used. In the traditional

stunning process, stunning is always accompanied by tetanus-like cramps, followed by strong convulsions, in fact this concomitant phenomena are the only proof of the effect of stunning. The consequences of the convulsions may be internal bleeding, injuries, even breaking of bones.

In the experiments, the procedure of stunning was foolowed by different phenomena. After the inception of stunning a convulsive state sets in not lasting more than 2 to 3 seconds. This stage is followed in about 5-7 seconds by complete relaxation. The animal retains this state of relaxation while being turned out from the revolving drum and stuck. According to the findings of vererinary control no internal haemorrhage was found in the pigs stunned by this method up to the present, whereas 40 % of the animals stunned by the traditional method suffered light haemorrhage and about 8 % severe ones.

The final aim of our experiments is to achieve by fixing the proper parameters, similarly to the narcotization with electric current in hospital practice, a state of narkosis in animals to be killed. In this case neither pain, nor convulsions occour and the consequent damages are also eliminated. This is therefore both from the point of view of humane slaughter as well as of economy the most advantageous method.

When planning the scheme of experiments, provision was made to be able to determine unambiguously the optimum conditions of stunning. The course of stunning and the quality of meat and offals as changing with stunning conditions are examined while descending from the initial high voltage and amperage values at various frequency values.

Literature.

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Benennung der Versuche	Amerika		Holland	Dänemark		Ungarn		
	I	II	Elther	I	II	Kapuvár	Schu. Schlacht Bp.	Kispest
V volt	150	150-400	150-500	70-90	240	70-90	70-90	70-90
R ohm	400	400	400	150	150	400	400	400
I Amp	0,5-1	0,35-0,75	1-2	0,5-0,8 0,2	0,85	0,6	0,3	0,2
t sec	0,5-2,35	2	0,5 1,5	10 18	10	1-2	4-5	8
Q A sec	1-2	0,75-1,5	1	8 1,4-2	8,5	1	1-1,5	1,5-1,8

Tabelle I. Kennziffern der in den verschiedenen Ländern gebräuchleichen elektrischen Betäubung.

Táblázat. Különböző országokban szokásos elektromos kábítások jellemző adatai.

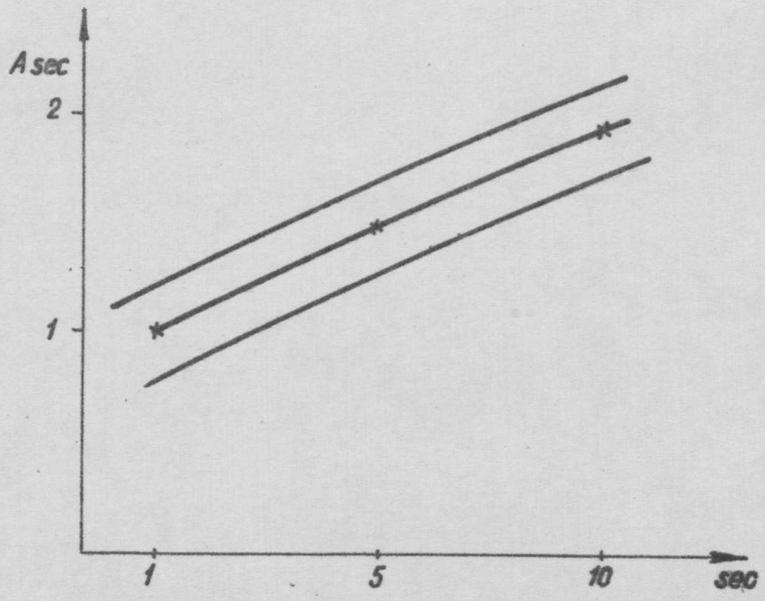

Bild.1. Füllmenge in Funktion der Zeit.

Töltésmennyiség az idő függvényében.

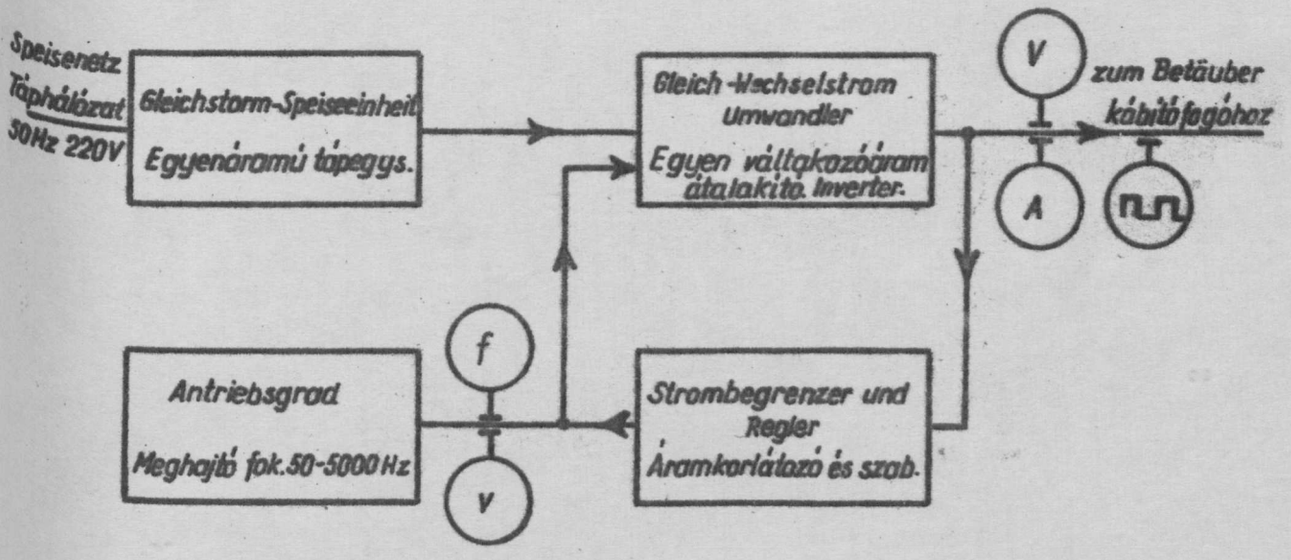

Bild 2. Blockschema

Kapcsolási vázlat.

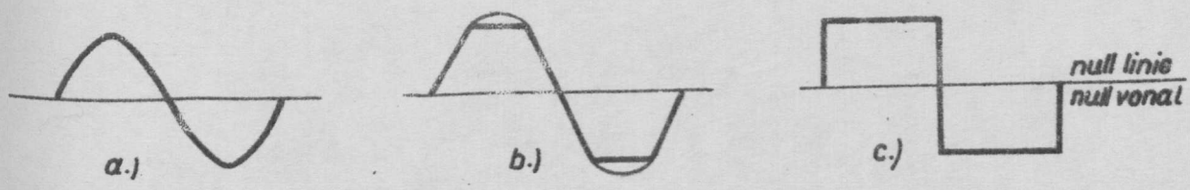

Bild 3. Formen der Stromwellen.

Áramhullám-formák.

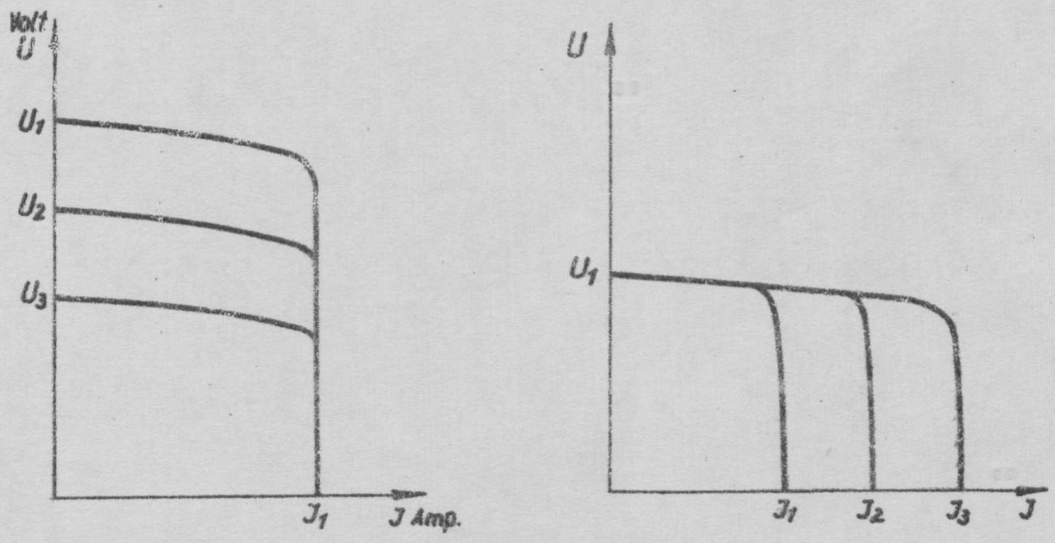

Bild 4. Betäubungsspannung in Funktion des Betäubungsstromes

Kábítófeszültség a kábítóáram függvényében.

Investigations into the Improvement of Electric Pig Stunning Technics

Á. Szücs, S. Bohn and A. Szabados

Although electric stunning has been applied for many years, it has not taken yet its final shape. The various types of stunning systems applied at present are not satisfactory, however the construction of a tool /of higher frequency/ with the aid of which immobilization may be achieved. The authors found that of the characteristics of the current applied /voltage, amperage, frequency, weve form, and time/ amperage is more decisive than voltage.

In view of the bodily resistance offered by the animal it is advisable to express the characteristic needed for stunning in terms of "quality of charge" /amperage x time/. By means of this expression all factors necessary for immobilization are given. To achieve good result, a certain quality of charge is wanted and if higher amperage is applied, relatively less charge or shorter time will produce the same effect.

Waveform and frequency also play an important part in stunning efficiency. These factors were varied with an apparatus constructed by the authors /this is an inverter containing a

transistor supplied by a direct current supply unit and controlled from a sine generator in which by varying voltage and frequency the waveform and frequency of the inverter may be set/.

The condition of the animals stunned with square wave and higher frequency current in a fixed state was satisfactory. After a convulsive stage, lasting only 2 to 3 seconds, relaxation takes place in about 3-5 seconds and this state will last after sticking. No internal haemorrhages were found in the animals thus stunned, in contrast with the 40 % haemorrhages occuring when conventional technique is applied.

Untersuchung einheimischer und ausländischer Betäubungsverfahren.

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Obgleich die elektrische Betäubung schon früher angewendet wurde, kann das Betäubungsverfahren auch heute noch nicht als ein vollkommen gelöstes Problem betrachtet werden. Die Anwendung der zur Zeit gebräuchlichen Betäubungseinrichtungen ruft Schmerzen bei den Tieren hervor, man kann sich aber eine Einrichtung vorstellen /mit höherer Frequenz/, durch welche die Ausschaltung des Bewusstseins schmerzlos erzielt werden könnte. Es wird betont, dass die Stromintensität und nicht die Spannung der wichtigste von den bei der Betäubung untersuchten Parametern /Spannung, Intensität, Frequenz, Wellenform, Zeitdauer/ ist.

Wegen des Körperwiderstandes drückt man richtiger den zur Betäubung nötigen Parameter anstatt der Spannung in sog. Elektrizitätsmenge /Intensität x Zeit/ aus. Auf diese Weise können nämlich die zur Betäubung nötigen Faktoren einfach angegeben werden. Zur richtigen Betäubung ist eine gewisse Elektrizitätsmenge notwendig. Wird eine höhere Intensität angewendet, so ist eine verhältnismässig kleinere Elektrizitätsmenge bzw. kürzere Betäubungszeit zu derselben Wirkung nötig.

Bei der Betäubung spielen Wellenform und Frequenz auch bedeutende Rolle. Diese Parameter wurde mittels eines von Verfassern konstruierten Instrumentes geregelt. /Das Instrument besteht aus einem von einer Gleichstromspeiseeinheit betätigten transistorierten Wechselrichter, welcher von einem Sinusgenerator gesteuert wird. Beim Sinusgenerator ist die Wellenform und die Frequenz des Wechselrichters durch die Änderung der Spannung und Frequenz einstellbar./

Der Zustand der in festgebundenem Zustand mit einem Strom von Rechteckwellen und höherer Frequenz betäubten Tiere war vollkommen befriedigend; bei der Betäubung tritt 2 - 3 sec lang ein krampfhafter Zustand auf, alsdann erschlaffen die Tiere vollkommen nach 3 -5 sec. Dieser Zustand bleibt auch nach dem Stechen erhalten. In inneren Organen der Tiere traten keine Blutungen auf im Gegensatz zu der 40 %igen Häufigkeit der bei den traditionell betäubten Tieren vorkommenden inneren Blutungen.

ИСПЫТАНИЯ ОТЕЧЕСТВЕННОЙ И ЗАРУБЕЖНОЙ ТЕХНОЛОГИИ ОГЛУШЕНИЯ.

А. Сюч, Ш. Бон и А. Сабадош: Электрооглушение применяют уже с давних пор, все таки еще до сегодняшнего времени этот метод не считается детально решенным вопросом.

В настоящее время применяемые оглушительные приборы причиняют скоту боль, но возможно разработать оборудование (высокой частоты) применением которого можно выключить сознание скота без болезни. Авторы подчеркивают, что из среды параметров исследуемых при оглушениях (напряжение, сила тока, частота, форма волны, срок) важнейшим параметром является сила тока а не напряжение.

Ввиду сопротивления тела, лучше если вместо напряжения, параметры необходимые для оглушения выразить в сумме заряда (сила тока х время). Этим способом факторы необходимые для достижения оглушенного состояния легко можно выразить, а именно, для хорошего оглушения необходимо использовать определенную сумму заряда, а если применяем большие силы тока то для достижения требуемого эффекта необходимо меньше суммы заряда или время оглушения.

В процессе оглушения важную роль играет, как уже было сказано, форма волны и частоты. Авторы, изменение двух

параметров достигли помощью самодельного прибора (транзисторным преобразователем действующим постоянным током получающий управляющий контур от генератора синус, у которого изменением напряжения и частоты можно установить форму волны и частоты преобразования).

Состояние скота оглушенных в неподвижном положении током четыреугольной волны и вышей частоты, оказалось вполне удовлетворительным:

при оглушении после 2 - 3 секунд судорожного состояния мышцы скота через 3 - 5 секунд совсем расслабляются и в таком состоянии остаются и после закола.

Кровоизлияния во внутренних органах небыло, в противоположности традиционным оглушениям, где частость кровоизлияния обыкновенно 40 %-ов.