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PRAGUE POSTAL TIME SERVICE: CLOCK AND SIRENS – IMPROBABLE CONNECTION

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Abstract. The goal of this paper is to present the origin, development, and technical parameters of the Postal Time Service, which was established in the capital of Czechoslovakia – Prague, gradually in the years 1933–1935. It also examines the options for determining "public time" in the period before the establishment of this service. In the second part, the text deals with the question of the use of the Postal Time Service infrastructure as an essential part of the air raid alarm siren system. The emergence of this system will be set in the broader context of the deteriorating security and political situation in Central Europe in the second half of the 1930s. In addition to the technical aspects of the warning system itself, the text will also introduce its author, Prof. František Rieger of the College of Mechanical and Electrical Engineering of the Czech Technical University in Prague, and the practical tests of the device, which took place in 1936 and 1937.

Keywords: History of technology, Prague Postal Time Service, Czechoslovakia, 1930s, synchronised clocks, anti-aircraft sirens, civil defence, František Rieger, Prague.

1. Introduction

Czechoslovakia was established on the 28th of October 1918 as one of the successor states of the Austro-Hungarian Monarchy by the declaration of the *Národní výbor (National Committee)* in Prague. On the 30th of October, the Slovak political representation also joined in by adopting the so-called Martin Declaration. For the next 20 years, the Czechs and Slovaks formed the basic state entity in the form of the political Czechoslovak nation. However, Czechoslovakia was characterised by a high proportion of other national minorities (Germans, Jews, Hungarians, Poles, Ruthenians, and others) whose loyalty to the common state varied during the interwar period. In terms of its foreign policy orientation, Czechoslovakia after the First World War oriented itself towards the Western victorious powers and became part of the so-called Versailles system of collective security. Immediately after its creation, however, it had to take an active militant stance to protect its borders (suppressing an attempt by the German minority to secede parts of the border areas, a short war with Poland, and a longer armed conflict with the Hungarian Soviet Republic over the southern parts of Slovakia). Despite the complicated international situation between the wars, the twenty years of the independent Czechoslovak state were marked by pluralistic democracy, industrial, scientific, and cultural cooperation with foreign countries, and social and economic growth [1].

The economic development was based on the historical Bohemian lands belonging to the most industrially developed parts of the former Habsburg monarchy. Existing and newly established enterprises (Škoda Works, ČKD, Zbrojovka Brno, Bat'a, etc.) thus formed an industrial base that not only met domestic needs, but also exported their goods all over the world [2]. Despite the turbulent political developments between the wars in Europe, Czechoslovakia remained the only democratic country in Central and Eastern Europe until 1938. In this political and economic context, the establishment of the Prague Postal Time Service (PPTS) and the system of air raid warning sirens can be seen as a purposeful effort by the state to improve the quality of public space and to fulfil the state's role of protecting the safety and health of its citizens. The Prague Postal Time Service[1] and the system of air raid warning sirens, which originated as two technologically intertwined sets, are among the least historically documented parts of Prague's municipal infrastructure. This article seeks to at least partially remedy this situation.

The Postal Time Service was the combination of two technological innovations implemented in the early 1930s. The first was the reconstruction of the network of the Prague pneumatic post, which provided the infrastructure for the distribution of time correction signals, and the second was the synchronisation of clocks in the main post office building in Jindřišská Street[2], from where these signals could be transmitted.

[1] In official documents, the designations Prague Postal Time Service, Postal Time Service and Time Service are used for this component of the postal administration. It is not clear which of the names was official. In the text, all three and the abbreviation PPTS are used.

[2] Jindřišská Street is located in the centre of Prague near Wenceslas Square. The construction of the Neo-Renaissance post office building began in 1871 and the post office has been located there since 1873. For more details, see [3].

The interest of the public and private or state enterprises, which until then had no economically attractive source of accurate time, also played a significant role.

The second part of the paper deals with the use of time of service equipment within a siren warning system. In the context of the deteriorating security and political situation in the 1930s, virtually all European countries proceeded to increase systematic efforts to protect civilians from air attacks [4, 5]. This took the form of raising awareness, the production and distribution of individual means of chemical defence (gas masks, protective suits, protective bags for newborns), the construction of shelters (especially at larger factories and plants, schools, hospitals, public buildings, as well as the digging of makeshift shelters in public spaces), and, last but not least, the construction of a system of alarm sirens. Czechoslovakia was no exception in this respect. It was able to rely on a well-developed domestic industry, including the electrical industry [6]. In 1936, under the leadership of František Rieger (1904–1986) [7], at that time an employee of the Postal Service, a technically unique system for warning sirens was built in Prague.

In researching both installations, we can ask ourselves a number of questions. In what socio-political context did they emerge, what demands did they respond to, and what technologies did they represent an alternative to? What were the advantages and disadvantages of the technologies chosen? We can also take this opportunity to briefly introduce the figure of the designer himself, František Rieger, who, after 1945, was a prominent lecturer in the field of low-current electrical engineering at the *Vysoká škola strojního a elektrotechnického inženýrství (College of Mechanical and Electrical Engineering of the Czech Technical University in Prague)* [6, pp. 101–122].

The content and scope of the paper are limited by the availability of archived materials and the virtual absence of secondary literature[3]. The personal collection of prof. Rieger is held in the Archives of CTU in Prague, which, in addition to basic biographical materials, also contains a report on tests of the siren alarm system [7, box 4, file Návrh na další využití kabelové sítě poštovní časové služby]. Another important primary source are the records of the *Ministerstvo pošt a telegrafů (Ministry of Posts and Telegraphs)*[4], stored in the National Archives in Prague[5]. However, researching in them is complicated by the extensive agenda that the Czechoslovak Post[6] had in its jurisdiction in the interwar period. In addition to delivering letters and parcels, it was responsible for the construction, management, and operation of telephones, telegraphs, and, to some extent, radio networks, granting concessions for radio receivers, operation of airmail, and, until 1932, the transport of passengers by bus. The Postal Time Service was a very small part of postal operations without its own separate administration. Its files are, therefore, scattered within the agenda of the *Ředitelství pošt a telegrafů (Directorate of Posts and Telegraphs in Prague)*, most often under the heading of technical telegraphic matters. The collections of the *XV. Oddělení Magistrátu Hl.m. Prahy (XV. Department of the Prague City Hall)*, which was in charge of the agenda of the Prague Electric Enterprises and cooperated with the postal administration on the implementation of both systems into the Prague infrastructure, has not been preserved at all [11].

The establishment of Czechoslovakia represented a significant breakthrough in the technical and urban development of Prague. From a provincial administrative centre of the Austro-Hungarian monarchy, it became the capital of the new republic. The period 1918–1938 is characterised by dynamic construction activity in Prague. This was not only to satisfy the spatial requirements of the new state authorities, industrial enterprises, and other production and services, and to provide housing for the growing number of inhabitants, but also to represent the new democratic and nation-building ethos of the state. Functionalism became the preferred architectural style, aesthetically and functionally distinct from the late 19th century styles associated with the Habsburg monarchy. Closely related to the development of the city was the development of technical and transport infrastructure. Let us mention at least the extension of the waterworks in Podolí, the rapid development of the tramway network, the complete rebuilding of the pneumatic post, the electrification of the Prague railway junction, the opening of the modern airport in Ruzyně near Prague, and the first, at that time unrealised, designs for the Prague metro [12]. The establishment of the PPTS can be seen in this context of efforts to build a modern urban complex with the appropriate infrastructure.

[3]The only secondary source focusing on the Prague Postal Time Service is an article written by prof. Rieger in 1985. See [8].

[4]This Ministry was established on the basis of Zákon č. 40 Sb. Z. a n. RČS z 13. novembra 1918 (Act No. 40 Coll. RČS of the 13th of November 1918). The activities that subsequently fell under its jurisdiction were excluded by this Act from the competence of the Ministry of Commerce, Industry and Trades, which was responsible for them in the Austro-Hungarian Monarchy. See [9].

[5]National Archives in Prague (NA), Collection of the Ministry of posts and telegraphs (MPT), 1918-1943, for the purposes of this paper boxes 855, 949, 951, 1060.

[6]The Czechoslovak Post was established as a state enterprise on the 1st of January 1925. This was on the basis of the Zákon o úpravě hospodaření ve státních závodech, ústavech a zařízeních, jež převahou nemají plniti úkoly správní č. 404 Sb. Z. a n. RČS z 18. decembra 1922 (Act on the Adjustment of Management in State Plants, Institutes and Establishments, which predominantly do not perform administrative tasks No. 404 Coll. of 18 December 1922) and the Vládní nařízení kterým se provádí zákon o úpravě hospodaření ve státních závodech, ústavech a zařízeních, jež převahou nemají plniti úkoly správní č. 206 Sb. Z. a n. z 25. septembra 1924 (Government Decree implementing the Act on the Adjustment of Management in State Plants, Institutes and Establishments, which predominantly do not perform administrative tasks No. 206 Coll. of 25 September 1924). See [10, p. 79].

The origins of the warning siren system, which is based on the PPTS can be traced back to the worsening political and security situation in Central Europe in the second half of the 1930s. From its inception, the political representation of Czechoslovakia considered the greatest foreign threat the secession in the mixed Czech-German border areas and the revanchist (irredentist) aspirations of the Kingdom of Hungary. It directed its diplomatic efforts as well as the concept of defence strategy towards their elimination[7]. Territorial problems with Czechoslovakia's other neighbours (Poland) were also addressed. Only the border with allied Romania and to some extent with internally weakened Austria could be considered secure. After Adolf Hitler came to power in 1933, the focus of Czechoslovak security strategy began to shift towards Germany. Efforts were stepped up to establish a stronger diplomatic link with France, and the modernisation of the army's weaponry and the construction of border fortifications were also initiated [14]. Czechoslovakia's situation worsened after Austria's annexation in March 1938. The escalating demands of Germany, the reluctance of the Western powers to actively come to its defence, and the disloyalty of part of its own (German, Hungarian) population forced the Czechoslovak government to cede the disputed territories according to the Munich Agreement in September 1938[8]. Thus weakened, the country finally succumbed to external and internal pressures in March of the following year [15]. One of the efforts of the Czechoslovak state to initially counter these growing threats was to improve the protection of the civilian population in the event of armed conflict. And one of the practical results was the establishment of a system of warning sirens in Prague.

2. Prague Postal Time Service

2.1. Public time before the establishment of the Prague Postal Time Service

Historically, the earliest way in which the inhabitants of European cities could access the time measured by mechanical machines was through tower clocks. These used to be placed on city landmarks, whether churches or representative town halls. Prague is unique in this respect, as the Old Town Clock is the oldest clockwork in use at its original location [17]. With the advent of the industrial age, associated with the development of transport and communication infrastructure (railways, telegraph), mechanical clocks began to appear on the buildings of post offices and railway stations. Between 1891 and 1911, the signal for 'accurate time' in Prague was a cannon shot at Letná. The cannon was placed on Bastion XIX and fired on the command of waving a flag, which was given at noon from the gallery of the Astronomical Tower in Klementinum. By this sound signal, the people of Prague set their clocks and watches [18]. The so-called "noon shooting" ended in 1911 with the construction of the Kramářova villa on Bastión XIX, which began in 1911[9].

In the 1920s, the company *Jednotný Čas (Normalised time)* began offering its services[10]. It was the Czech branch of the German firm Elektrozeit, which was represented in this enterprise with 40 % of the capital investment and also provided technical equipment and production capacities. Jednotný Čas supplied a system of secondary clocks synchronised from the master machine, which it offered to larger offices and factories [19]. For the public and smaller businesses, a system of non-synchronised electric clocks was provided. These were placed perpendicularly on the facades of businesses that subscribed to their service[11], so that the time was available to the public and thus served as a form of marketing. The clocks were powered by a battery located in the building[12]. Powering them from the mains was not possible as the current fluctuated and would have prevented the clock, which had no synchronisation device, from being accurate.

However, even the battery power supply did not lead to the desired accuracy of the clock, which, together with the mechanical public clocks notorious for their inaccuracy, became the object of complaints and jokes. This fact was reflected, for example, by the playwright Arnošt Dvořák and the philosopher Ladislav Klíma in their play Matěj Poctivý, whose protagonist describes the beginning of his career as follows:

"In our town, not one clock was reading accurately despite all the expense to the clockmakers for constant repairs. So, it was decided to set up wooden booths behind each clock, well heated in winter, and to employ healthy, mentally capable men to move the raffia of

[7] In 1920–1921, the so-called Little Entente (Malá dohoda) was established on the initiative of the Czechoslovak Minister of Foreign Affairs and later President Edvard Beneš. It was an alliance of Czechoslovakia, Romania and Yugoslavia, i.e. states that were united by the threat of Hungarian territorial claims. See [13].

[8] The Munich Agreement was an accord between Germany, Italy, France and Great Britain represented by Adolf Hitler, Benito Mussolini, Édouard Daladier and Neville Chamberlain to cede the border territories of Czechoslovakia to Germany. It was negotiated on the 29th of September 1938 in Munich and signed without the Czechoslovak representation.

[9] Neo-Baroque villa, built between 1911 and 1914 on Bastion XIX (St. Thomas's Bastion) designed by architect Friedrich Ohmann for Karel Kramář. Karel Kramář was an important Czech, later Czechoslovak politician, the first Prime Minister of independent Czechoslovakia. The villa that bears his name is currently the official residence of the Czech Prime Minister.

[10] The company was based in Prague-Karlín and its managing directors were Vladislav Havlíček and Vítězslav Heckler. The company did not have its own production capacities, it purchased licensed technical equipment from the Elektrozeit company of Frankfurt am Main [19].

[11] The business model of Jednotný čas was specific in that it did not sell clock equipment to customers, but rented it.

[12] Batteries of this kind were produced in Czechoslovakia by the Palaba company from Slaný. See for example, its offers of dry cells for telephone and signal purposes published regularly in the *Elektrotechnický obzor (Electrotechnical horizon)* Journal (*Elektrotechnický obzor*, vol. 22, Praha 1933) For the history of the Palaba company see [20].

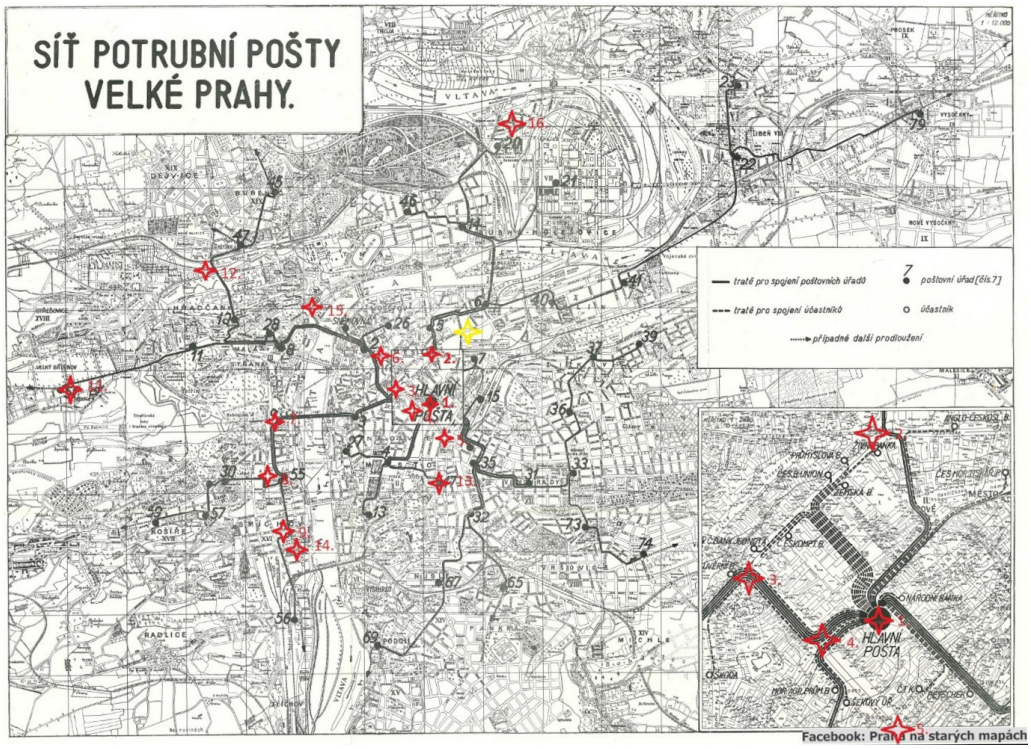

FIGURE 1. Map of the pneumatic pipe network with sirens indicated [16]. The map shows the 12 lines of the Prague pneumatic pipe. The red symbol marks the location of individual sirens. Their numerical designation corresponds to the list given in this text. Missing is No. 13, the siren in Vokovice. The yellow marker indicates the siren on the roof of the AXA Palace, in Na Poříčí Street, which was tested by the municipal administration in 1936.

the public clocks accurately every minute according to their pocket watches. So, I have become a shifter of the clock hands, I have a handsome salary, the public a reliable time, and everybody is satisfied." [21, translated by author].

There was thus a demand from the public for a reliable and affordable means of displaying accurate time to the public. This demand was to be filled by the new time service of the Prague Post and Telegraph Administration.

2.2. Establishment of the Prague Postal Time Service

The creation of the PPTS itself was preceded by two technical innovations implemented by the postal administration in Prague at the turn of the 1920s and 1930s.

The first of these was the reconstruction of the pneumatic post network. The original one was built in 1887 and its 5 363 metre long pipeline connected the main post office in Jindřišská Street with the branches in Prague's Mala Strana, Old Town and Vinohrady districts [22]. Full reconstruction began in 1928 and lasted until December 1932. After its completion, the network reached a length of 50 675 metres [22]. The technical equipment was supplied by the Berlin firm *Mix & Genest* [23, box 951, file Potrubní pošta]. The central hub was again in Jindřiška Street and this time it connected 37 post offices as well as private customers and state institutions. The state of the network is shown in more detail on the map in Figure 1. Along with the pipes, a set of cable lines was laid under the city pavement, some of which were temporarily unconnected [24]. The fundamental technological change that differentiated the old and the new pneumatic post system was the way in which the mail was transported. In both cases, the casings containing the letters themselves were driven by compressed air in the pipe. The old system was powered by one central compressor which had to be in continuous operation no matter how many parcels the system was carrying at any given time. Following the rebuild and significant expansion of the network, smaller, separate compressors were installed for each branch of the pneumatic post [24]. Their output could thus be regulated according to the level of current use of a particular branch of the system, which allowed more economical operation of the entire grid [25]. The cable lines laid along the pipelines during the reconstruction were used to control the more remote technologies of the decentralised system from the switchboard in Jindřišská Street.

The second technical innovation was the synchronisation of the time devices in the main post office building in Jindřišská Street[13]. This was mainly re-

[13] A time synchronisation system contains two basic elements: a master (primary) clock and a slave (secondary) clock. The secondary clocks are connected to the master clock by a wire in which electrical impulses are transmitted at regular intervals. The polarity of these pulses' changes with each alternation of

quired by the increasing demands on the indication of precise time for the needs of the ever-developing long-distance communication networks (radio telegraphy, long-distance telephone lines and teletypewriting). A room in the post office building was structurally modified, soundproofed, and isolated as much as possible from mechanical shocks from the outside environment. Two master clocks (control clocks) supplied by *Elektrotechna*[14] under license from *Siemens* [28, p. 553] were installed in this room. The primary clock had a nickel steel second compensated pendulum with an accuracy of at least ±0.5 seconds per 24 hours [29, p. 362]. The backup clock had a plain steel pendulum. The whole setup can be seen in Figure 2. Both machines sent minute correction signals and were themselves synchronised from the astronomical chronometer at the *Státní observatoř Klementinum (State Observatory in Klementinum)* [30, p. 12]. Two 60 V batteries with a capacity of 70 Ah, one of which was a backup, served as the power source. This device was initially used to correct the 17 sub-clocks in the same building [29, p. 361].

The combination of these two systems (the pneumatic tube and the time synchronisation of the equipment in Jindřiška Street) formed the technological basis of the Prague Postal Time Service. Signals from the master clocks were routed through a previously unconnected cable line in the path of the pneumatic tube and were used to correct the clock machinery in the individual post offices located along the route. The entire system was put into operation in early 1933 and had 12 basic circuits that corresponded with the 12 lines of the pneumatic tube [31, p. 115].

The following year, the Post Office offered the use of the time service to the Prague City Hall. The contract was signed, and the construction work was carried out in the first half of 1935 [23, box 855, file Časová služba – připojování soukromých účastníků].

Thus, new clock stands of the Postal Time Service began to appear in the streets of Prague. The first public ones were on the Republic Square, and the first private customer was the café Urbanka on Malá Strana [29, p. 28]. It is impossible to determine their exact number or locations at the present state of research. František Rieger mentions 200 clocks in his article [29, p. 28], but these are probably the clocks of the post office, state offices, private customers,

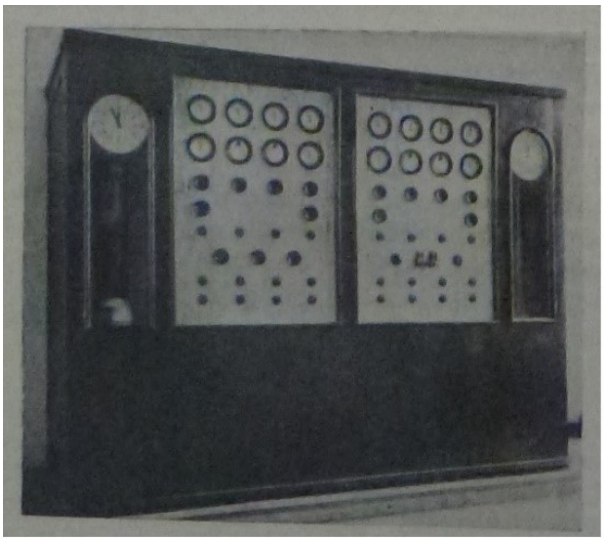

Figure 2. Main and backup master clocks and dashboards with control mechanisms for individual branches of the PPTS, located in the post office building in Jindřišská Street [30, p. 12].

and street clocks. However, with the advent of the PPTS clocks, the machines from the other systems did not disappear from the streets of Prague, and both systems coexisted in the public space.

The Postal Administration tried to extend the time service to locations outside Prague. In January 1936, it sent its employee František Rieger to negotiate with the Baťa company in Zlín [23, box 949, file Časová služba – Jednání s firmou „Baťa Zlín“]. Negotiations were ultimately unsuccessful, but they allow us to get an overview of the entire system's technical possibilities and the commercial arrangements for connecting private subscribers, which also applied to customers in Prague. The Baťa plants in Zlín then had their own time system, consisting of eight master clocks and 737 slave clocks, but without central synchronisation. The Postal Administration offered to connect this system to the central correction signal of the PPTS. This impulse was to be transmitted from Prague to Zlín over the so-called phantom telephone line[15]. The fee for providing this service was CZK 600 as an annual flat rate for the signal transmission and CZK 8 for each connected clock [23, box 949, file Časová služba – Jednání s firmou „Baťa Zlín“]. The extension to Zlín was to be the first step towards expanding the PPTS; other proposed locations included Pardubice, Brno, and Olomouc[16]. After the collapse of negotiations with Baťa, this was not carried out.

the interval. The secondary clocks include an electromagnet with a rotor that spins their mechanism with each signal. The accuracy of the whole system, therefore, depends on the accuracy of the master clock. The PPTS system actually had two of these synchronisations. The first master clock was the precision astronomical chronometer in Klementinum, which controlled the master clock in the post office. These in turn synchronised the secondary clocks throughout the network. As the voltage dropped with the length of the line and with the increasing number of connected clocks, so-called translational relays were used for longer lines, which replicated the correction signals using their own voltage source. See [26].

[14] Elektrotechna was a subsidiary of the German concern Siemens. It was founded in 1929 and primarily produced telephone and railway signaling equipment. See [27].

[15] Phantom lines are used in long-distance telephone connections to increase transmission capacity. The principle of their operation is to link the signals to the transformer centres of two lines, thus creating another circuit. See [32].

[16] From a technological point of view, the possibilities of expanding the PPTS were limited by the capacity of the long-distance telephone lines, i.e. phantom lines had to be laid in that direction.

Despite unsuccessful attempts to extend the services of the PPTS outside Prague, this enterprise represented a welcome source of income for the Czechoslovak Post. In assessing the economic aspects, it must be taken into account that the whole system was set up at minimal cost. Both the construction of the time control room and the reconstruction of the pneumatic tubes were independent of the establishment of the PPTS. The cost of constructing the branch lines to private or public customers was charged to the customer. The whole system was designed so that its operation was not affected by the number of clocks connected so that even the increasing number of them did not require additional expenditure. One way to further enhance the profit from the operation of the PPTS was to use the public clock sites for advertising purposes. In 1935, the Postal Administration invited several graphic design firms to submit bids for the construction of a sizeable illuminated advertisement to be placed on the post office building in Jindřišská Street. The proposals for the installation included, in addition to a clock face, the inscription ČASOVÁ SLUŽBA (TIME SERVICE) [23, box 1060, file Časová služba. Reklamní hodiny]. Five companies submitted bids[17], but time-consuming negotiations with them, as well as changing requirements of the postal administration, led to none of the proposals being realised in the end. However, the PPTS eventually found other uses as part of an alarm siren system to protect the public from air attacks.

2.3. Passive protection of the population against air attacks in Czechoslovakia until 1938

The origins of organised protection of the population not only against air attacks in Czechoslovakia date back to 1929, when the Ministry of National Defence initiated the establishment of the Ústředí obrany obyvatelstva (Office of Population Defence). It was a voluntary defence organisation which, with the support of the state authorities (the Ministry of National Defence and the municipalities in which the organisation had branches), set itself the goal of studying and preparing the organisation of anti-aircraft protection of the population [4, p. 19]. More important in terms of practical results was the adoption of *Zákon č. 82 o ochraně a obraně proti leteckým útokům ze dne 11. dubna 1935 Sb. z. a n. RČS* [33] *(Act No 82 of 11 April 1935 Coll. on protection and defence against air attacks)*. Based on this law, the most critical component in the protection of the population was the local government, i.e. the municipality or town. Its authorities carried out practical steps to ensure safety and created conditions for cooperation between private organisations and individuals. An advisory board was created within the Ministry of the Interior, which was responsible for civil air defence (from now on referred to as CAD) in peacetime. Its equivalent, at a lower level, was local advisory committees assisting individual mayors. Towns with a population of more than 50 000 were divided into wards and then into districts. Cities with 10–50 thousand inhabitants were divided into districts, and smaller municipalities formed a single unit in air defence. The law ordered the municipalities to build a system of warning announcements and construct shelters for the population. Since the organisational and especially financial possibilities would not allow the municipalities to build these facilities in the full extent, the law anticipated the involvement of private sources. Therefore, together with *Vládní nařízení č. 103 Sb. z. a n. RČS z 29. dubna 1935* [34] *(Government Decree No 103 Coll. of 29 April 1935)*, conditions were created for a tax relief on the construction of shelters. In addition to municipalities, individual state institutions and larger industrial enterprises also organised air defence on their account. Steps were also taken to speed up and make the production of so-called people's civilian masks cheaper and to distribute them among the general public[18]. The first competition for producing this type of mask was announced as early as 1933, but due to technical and administrative complications[19], the mass production did not occur until 1937 [36, p. 73]. Therefore, the army masks of pattern no. 23 [37, p. 160] had to be used in the first CPO anti-aircraft exercises. The production and distribution, tied to a concession, were subject to strict state supervision according to *Vládne nariadenie č. 83. zo dňa 17. dubna 1935 (Government Decree No. 83 of 17 April 1935)* [4, p. 19].

As the threat to the nation gradually increased, so did the pace of CAD development. Promotional publications were issued, and exercises and various agitation events were organised, often in collaboration with the Ministry of National Defence. The construction and modification of shelters and warning systems also intensified, especially in major cities. To cover the rising costs associated with this activity, *Zákon č. 75 Sb. z. a n. RČS z 8. dubna 1938 (Act No 75*

[17] Companies Jan Klusal, Bohdan Gerhard, František Kříž, V. Haman a spol., and Oskar Ježek. These were Prague businesses for letterpress printing and the production of illuminated advertisements. See [23, box 1060, file Časová služba. Reklamní hodiny].

[18] Gas masks were produced by the Prague company Horák under the British licence of Leyland and subsequently by a number of manufacturers, e.g. Fatra Napajedla (in cooperation with Baťa), Chema Lutín, Kudrnáč, Optimit, Palaba Slaný and others. In 1936, the Czechoslovak industry had an annual capacity of over 120 000 protective masks and 250 000 filters for both the military and civilians who were regularly trained to use them (even for infants and small children) [35].

[19] The main producer of the people's mask was the company Fatra Napajedla. The discrepancy in the negotiations between the Ministry of the Interior and the Ministry of National Defence on the one hand and Fatra on the other hand was primarily over the cost of the mask. The price had to be as low as possible in order to make it accessible to the general public. This requirement was initially difficult to meet, as the mass production of gas masks in the mid-1930s made it necessary for Fatra to introduce new technological processes. The price was eventually set at 99 Czechoslovak crowns. See [36].

of 8th of April 1938) was issued, which concerned the collection of a special levy for protection against air attacks [38].

Under these circumstances, in 1936, a system of warning sirens was built in Prague, the author of which was František Rieger.

2.4. Prof. František Rieger

František Rieger (1904–1986; see Figure 3) was born into a civil servant family on the 4th of May 1904 in Pardubice. After his father died in 1907, the family moved to Prague. He completed his secondary education in 1922 with a matriculation diploma at the Czech State Realschule in Prague's Mala Strana district. He then attended the *Vysoká škola strojního a elektrotechnického inženýrství (College of Mechanical and Electrical Engineering of the Czech Technical University in Prague)* and graduated with a second state examination in 1927. In 1931, he received the degree of Doctor of Technical Sciences. Between 1927 and 1929, he worked briefly in the Prague branch of the Philips company and then at the *Vojenský výskumný ústav (Military Research Institute)* [39, p. 152].

In 1929, Rieger became an employee of the Poštovní a telegrafní správa (Post and Telegraph Administration). During his time at the Postal Administration, he participated in the construction of the Prague telegraph central station, the relocation of cable lines in Prague – Klárov, and the laying of new cables for reserve telephone and telegraph exchanges in Wenceslas Square in Prague, extensive reconstruction and study work on the Prague-Brno long-distance cable, the construction of synchronisation equipment for Hradec Králové, and the construction of radio stations in Liblice and Mělník, a time service network and a time control centre in Prague, equipment for broadcasting radio signals and the construction of a warning siren system. A question of further research is his contribution to the drafting of Czechoslovak Patent No 54210[20] *"Synchronizace samostatně jedoucích hodin korekčními impulsy vysílanými simultánně z časové ústředny po telefonních vedeních (Synchronisation of independently running clocks by correction impulses transmitted simultaneously from a time control centre over telephone lines)."* [40].

In 1945, at the request of the dean's office of the *College of Mechanical and Electrical Engineering*, Rieger

Figure 3. Prof. František Rieger in the 1930s [7, box 8, sign. VIII/1, file Fotografie].

was transferred by the Ministry of Posts to *Ústav elektrotechniky slabých prúdov (Institute of Electrical Engineering of Weak Currents)*[21]. From then on, his life was connected with his work at the CTU in Prague. Ge habilitated there in 1946 as an associate professor of weak current electrical engineering [7, box 1, sign. I/2, file Životopisy]; a year later, he was appointed state associate professor of communications electrical engineering. In 1956, he was appointed professor of circuits and theory of signalling technology [39, p. 153], becoming a full professor in 1966 [7, box 1, sign. I/2, file Životopisy]. During his tenure at the Faculty of Electrical Engineering of the CTU in Prague, he held several important academic positions, in 1953–1955, he was vice-dean of the faculty. In addition to lecturing, he contributed to the education of new professionals by writing a number of textbooks and three national scientific textbooks – *Theorie přenosu sdělovacím vedení (Theory of transmission through communication lines)* [42], *Lineární obvody (Linear circuits)* [43] and *Teorie sdělovací elektrotechniky (Theory of Communication Electrical Engineering)* [44]. He retired in 1970, but continued to lecture at the college, first part-time and then as a visiting faculty member until 1978 [7, box 1, sign. I/2, file Životopisy]. Even after leaving the faculty, he remained active in publishing [8, 41].

[20] On the patent file, which is located in the archives of the Industrial Property Office, the applicant is listed as Ing. Rudolf Rod. However, Professor Rieger states his authorship of this patent in his curriculum vitae prepared for the Faculty of Electrical Engineering of the Czech Technical University in Prague and, in 1934, he published an article in *Elektrotechnický obzor (Electrotechnical horizont)* entitled *Nový způsob synchronizování kyvadlových hodiny elektr. impulsy opakovanými v hodinových intervalvalech (A new method of synchronising pendulum clocks with electrical impulses repeated at hourly intervals)* in which he describes the same device as in the patent. The filing protocols for 1934 when this patent was applied for have not been preserved. Thus, the authorship will have to be determined by future research.

[21] This institute was originally established as Stolice elektrotechniky slabých proudů (Chair of Electrical Engineering of Weak Currents) in 1921. From the beginning, it was led by prof. Ing. Adolf Šubrt. The initial subject of the institute's research was telephony, later, its focus expanded to most areas of weak-current communication electrotechnics. After the retirement of prof. Šubrt in 1950, František Rieger took over the management of the Institute. See [41].

3. Alarm siren system

3.1. Technical aspects of the system

The basis of Rieger's alarm siren system was the Postal Time Service network. The network, about 50 km long, located some 80 cm below the surface, was divided into 12 loops and controlled from a central clock in the main post office building on Jindřišská Street [7, box 4, file Návrh na další využití kabelové sítě poštovní časové služby, p. 40]. These sent out a three-second signal every minute with a current intensity of 0.4 Amp [7, box 4, file Návrh na další využití kabelové sítě poštovní časové služby, p. 40]. Rieger's system involved the installation of electric sirens directly to the clock stands, equipped with a mercury or mechanical switch that would not respond to the 0.4 Amp current, as can be seen in Figure 4. In the event of an air raid alert, an additional 0.6 Amp [7, box 4, file Návrh na další využití kabelové sítě poštovní časové služby, p. 40] pulse would be applied to the time service circuit to open the siren control relays, which would then be brought into operation simultaneously. The voltage in both pulses was the same, 60 V [7, box 4, file Návrh na další využití kabelové sítě poštovní časové služby, p. 10]. The alarm current was interrupted during its connection by a two-position switch used to change the rhythm of the siren signal. This change heralded the beginning and end of the alarm. According to the original drawings, the individual devices were also to include a light panel with the word POPLACH (ALARM), which was to be illuminated when the siren was triggered. This feature was not ultimately installed, presumably because it would have violated the principles of blackout in the event of warnings at night.

3.2. Tests of the system

The entire system was designed and built relatively quickly during 1936. The Prague City Committee of the CAD originally wanted to install a smaller number of more powerful sirens. However, the plan was abandoned in March 1936 after a test of a 60 hp siren. It was placed on the roof of the functionalist AXA palace in the centre of Prague, on Na Poříčí Street, and its acoustic range proved insufficient. Rieger had been working on his system since January of that year and thus presented a finished design at a meeting on other possibilities for powering alarm sirens held in early June under the auspices of the *Ministry of Posts and Telegraphs* [7, box 4, file Návrh na další využití kabelové sítě poštovní časové služby, p. 49]. Based on it, the first siren, placed on the clock cabinet in Republic Square, was already approved on the 16$^{\text{th}}$ of September. It had a power of 2 hp. After testing it, the ČKD factory in Prague was awarded a contract to manufacture 16 alarm switches [7, box 4, file Návrh na další využití kabelové sítě poštovní časové služby, p. 52]. These were installed in the following locations after the delivery together with the sirens:

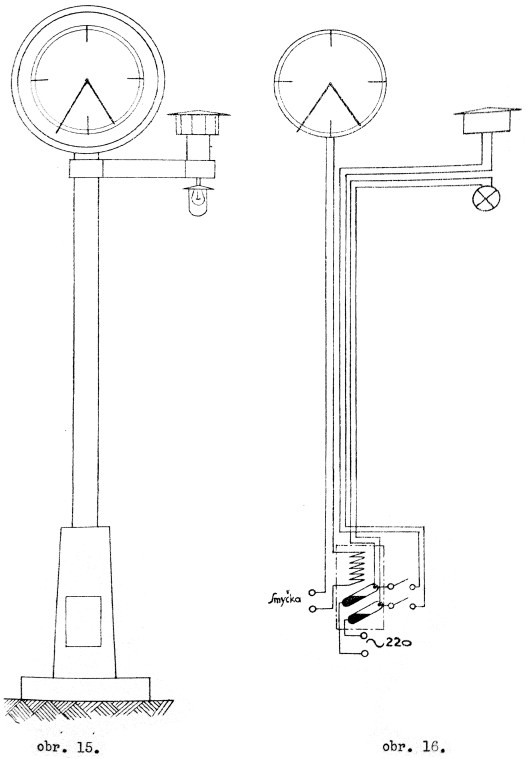

Figure 4. Diagram of siren connection to the street clock of the PPTS system [7, box 4, file Návrh na další využití kabelové sítě poštovní časové služby, p. 4].

(1.) On the main post office,
(2.) on the Republic Square,
(3.) on Můstek,
(4.) in the middle of Wenceslas Square,
(5.) by the National Museum,
(6.) at the Old Town Hall,
(7.) in the Újezd,
(8.) in Arbes Square,
(9.) in Anděl,
(10.) in Vokovice,
(11.) in Břevnov,
(12.) on Bruska waterstation,
(13.) in Sokolská street,
(14.) on Smíchov powerplant,
(15.) on Klárov transformation station,
(16.) on Holešovice powerplant [7, box 4, file Návrh na další využití kabelové sítě poštovní časové služby, p. 56].

The location of the sirens is shown in Figure 1.

In addition to rapidity, the construction of the system was also characterised by relatively low construction costs, which was also due to the use of existing infrastructure. František Rieger estimated that constructing a new overhead line for the needs of a warning siren network of the same scale would cost

CZK 200 000 [7, box 4, file Návrh na další využití kabelové sítě poštovní časové služby]. However, this line would also be much more susceptible to damage by sabotage or bombing.

The first major exercise of the Prague CAD involving the new siren system took place on the 20$^{\text{th}}$ of November, 1936 [37, p. 151]. During it, in cooperation with the Ministry of Defence, a mock raid on Prague with simulated bomb explosions was carried out. The CAD headquarters was located in the Old Town Hall. After receiving a report of approaching aircraft from military sentries in the vicinity of Prague, the order to activate the sirens was signalled to the main post office building by a telegraph at 14:55. A watchman was stationed at each of them to record any malfunctions. The end of the alarm was announced at 15:07. During its duration, all sirens operated without failure. Subsequently, the electrical time clocks were also checked, and it was found that the operation of the sirens did not affect the accuracy of their operation [7, box 4, file Návrh na další využití kabelové sítě poštovní časové služby, p. 58].

The second exercise was a practice raid by nine bombers on the 26th of May 1937 [37, p. 151]. It again involved all elements of the CAD as well as gendarmerie, firefighters, army, and medical personnel. The planes, taking off from the Hradec Králové airport, fired white flares simulating bombs while flying over Prague and the surrounding villages. The overflights continued into the night to assess, among other things, the effectiveness of the blackout [37, p. 151]. The sirens were again controlled indirectly from the Old Town Hall. Their sound was also the signal for the activation of the other sound warnings. These included the ringing of the bells on police cars and fire engines, and the sirens in factories that were not connected to the central system. This exercise also highlighted the biggest weakness of the Rieger warning system, which was its direct connection to the existing infrastructure. The extent of this infrastructure (the pneumatic tube) also determined the geographical extent of the siren locations. The more remote areas of Prague, which were not served by the pneumatic tube, were thus excluded from the system. During the exercise, it was observed that the sound of the alarm did not reach some parts of the city further away from the centre (Zlíchov, Radlice, Košíře) [37, p. 152].

4. Conclusion and perspectives for further research

The Czechoslovak Republic, as the successor state of Austria-Hungary, had to deal not only with the ethnic issues after its establishment, but it also had to be able to protect its borders set at the Versailles peace negotiations and to deal with the economic problems after the end of World War I. Diplomatically, as a pluralist democracy, it tried to join the collective Versailles system, in which the Western states, primarily France, were to be the guarantors of her territorial integrity. Twenty years of its independent existence brought economic, social, and cultural development, which could rely on an advanced industrial base. One of the responsibilities assumed by the Czechoslovak state was the care of public services and the protection of the health and safety of the population. In the context of these efforts, the Prague Postal Time Service and the resulting system of alarm sirens were established in the 1930s.

The development of Prague as the capital of the newly formed Czechoslovakia brought with it the construction of transport and communication infrastructure as well as residential, administrative, and representative buildings. These changes were intended to meet the growing demands of the state administration and the general public for the kind of services that were associated with the operation of a modern western metropolis. The creation of the PPTS was one of many aspects that were to contribute to the attainment of this urban status.

The PPTS was created as a result of the combination of two existing technological systems, the pneumatic tube network and the time control centre. Its commissioning gave Prague's public and private enterprises and state institutions access to reliable and affordable clock network. Such a service was noticeably lacking in the public domain at the time. Companies such as Jednotný čas did offer electric clock systems for rent, but these were either limited to systems within a single company or were individually installed clocks without synchronisation. The postal administration was aware of the advantages of its system and, therefore, in the second half of the 1930s, attempted to extend it outside Prague and to make further commercial use of clocks for advertising purposes. However, neither of these projects was implemented. The PPTS system did, however, find its use as the basis for a set of alarm sirens, completed in 1936 by František Rieger.

The CAD Prague siren system designed by František Rieger was created during an increasing threat to the Republic. From the mid-1930s onwards, the leading foreign threat to Czechoslovakia was no longer posed by the territorial demands of the Kingdom of Hungary. They were replaced by the increasingly openly declared demands of the German government under Adolf Hitler for the border territories inhabited by the German minority and mixed population, whose loyalty to Czechoslovakia declined in proportion to its increasing radicalisation. These efforts to revise the so-called Versailles system were backed by massive armaments on the part of Germany. The Czechoslovak government continued to rely on the collective security system, of which France was to be the main guarantor in Central Europe. In addition, it also started building fortifications in the border area and modernising its army, which could rely on an advanced domestic arms industry. Another of the Czechoslovak state's responses was to seek quick and

cost-effective solutions to improve the protection of the civilian population from air attacks. It can be concluded that the system under study fulfilled both of these requirements. It made use of the existing infrastructure, which was largely protected from damage by its underground placement. And at the same time, the whole mechanism was designed in such a way that it did not interfere with the operation of the postal time service. However, using existing lines was also its greatest weakness, as it limited the choice of locations for the sirens. This became apparent during an exercise in May 1937. The geographical limits of the expansion of both systems, as well as the fact that some parts of the city remained uncovered, are clearly shown in the attached map (Figure 1). Thus, the use of the existing infrastructure, which allowed both the rapid construction of the PPTS and the inclusion of the sirens, also remained their greatest weakness.

From the perspective of the history of science and technology and Prague's urban history and urbanization changes in the period under study, both described systems are among the most unique devices. The availability of archival sources limits their further research. However, it can be perspectively outlined in two directions. The first is the question of the use of the alarm siren system in actual combat conditions, i.e. during a series of Allied air raids on Prague in 1944 and 1945. The second line of research overlaps with the present. Clocks on the streets and civil defence sirens remain in Prague's public space today. They are technically differently, but they still serve the same purpose.

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